

Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2010–2014)

S. Butler and S. Coffen-Smout

Oceans and Coastal Management Division
Ecosystem Management Branch
Fisheries and Oceans Canada
Maritimes Region
Bedford Institute of Oceanography
PO Box 1006
Dartmouth, Nova Scotia, Canada
B2Y 4A2

2017

Canadian Technical Report of Fisheries and Aquatic Sciences 3199



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in the data base *Aquatic Sciences and Fisheries Abstracts*.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications à part entière. Le titre exact figure au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la base de données *Résumés des sciences aquatiques et halieutiques*.

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Canadian Technical Report of
Fisheries and Aquatic Sciences 3199

2017

Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2010–2014)

by

S. Butler and S. Coffen-Smout

Oceans and Coastal Management Division
Ecosystem Management Branch
Fisheries and Oceans Canada
Maritimes Region
Bedford Institute of Oceanography
PO Box 1006
Dartmouth, Nova Scotia, Canada
B2Y 4A2

© Her Majesty the Queen in Right of Canada, 2017.
Cat. No. Fs97-6/3199E-PDF
ISBN 978-0-660-07403-0 ISSN 1488-5379

Correct citation for this publication:

S. Butler and S. Coffen-Smout, 2017. Maritimes Region Fisheries Atlas: Catch Weight Landings Mapping (2010–2014). Can. Tech. Rep. Fish. Aquat. Sci. 3199: 57 pp.

TABLE OF CONTENTS

LIST OF FIGURES	iv
LIST OF TABLES	v
ABSTRACT	vi
RÉSUMÉ	vi
INTRODUCTION	1
METHODS	1
Data Processing	1
Data Aggregation	4
Privacy Screening	4
FISHERIES DESCRIPTIONS AND CATCH WEIGHT LANDINGS MAPS	5
ACKNOWLEDGEMENTS	56
REFERENCES	56

LIST OF FIGURES

- Figure 1.—Aggregating fisheries catch weight landings within 2 x 2 minute grid cells.
- Figure 2.—Groundfish Landings (All Species), 2010–2014
- Figure 3.—Groundfish Bottom Trawl Landings, 2010–2014
- Figure 4.—Groundfish Gillnet Landings, 2010–2014
- Figure 5.—Groundfish Longline Landings, 2010–2014
- Figure 6.—Seasonal Groundfish Landings, January–March, 2010–2014
- Figure 7.—Seasonal Groundfish Landings, April–June, 2010–2014
- Figure 8.—Seasonal Groundfish Landings, July–September, 2010–2014
- Figure 9.—Seasonal Groundfish Landings, October–December, 2010–2014
- Figure 10.—Atlantic Cod Landings, 2010–2014
- Figure 11.—Atlantic Cod, Haddock and Pollock Landings, 2010–2014
- Figure 12.—Flatfish Landings, 2010–2014
- Figure 13.—Atlantic Halibut Landings, 2010–2014
- Figure 14.—Greenland Halibut (Turbot) Landings, 2010–2014
- Figure 15.—Hagfish Landings, 2010–2014
- Figure 16.—Cusk Landings, 2010–2014
- Figure 17.—Dogfish Landings, 2010–2014
- Figure 18.—Redfish Landings, 2010–2014
- Figure 19.—Red Hake Landings, 2010–2014
- Figure 20.—Silver Hake Landings, 2010–2014
- Figure 21.—Monkfish Landings, 2010–2014
- Figure 22.—Sculpin Landings, 2010–2014
- Figure 23.—Skate Landings, 2010–2014
- Figure 24.—Squid Landings, 2010–2014
- Figure 25.—White Hake landings, 2010–2014
- Figure 26.—Wolffish Landings, 2010–2014
- Figure 27.—Herring Landings, 2010–2014
- Figure 28.—Mackerel Landings, 2010–2014
- Figure 29.—Bluefin Tuna Landings, 2010–2014
- Figure 30.—Large Pelagics Landings, 2010–2014
- Figure 31.—Swordfish Landings, 2010–2014
- Figure 32.—Albacore, Bigeye and Yellowfin Tuna Landings, 2010–2014
- Figure 33.—Porbeagle, Mako and Blue Shark Landings, 2010–2014
- Figure 34.—Snow Crab Landings, 2010–2014
- Figure 35.—Crab Landings (All Species), 2010–2014
- Figure 36.—Scallop Landings, 2010–2014
- Figure 37.—Seasonal Scallop Landings, January–March, 2010–2014
- Figure 38.—Seasonal Scallop Landings, April–June, 2010–2014
- Figure 39.—Seasonal Scallop Landings, July–September, 2010–2014
- Figure 40.—Seasonal Scallop Landings, October–December, 2010–2014
- Figure 41.—Offshore Clam Landings, 2010–2014
- Figure 42.—Shrimp Landings, 2010–2014
- Figure 43.—Offshore Lobster Landings, 2010–2014
- Figure 44.—Grey Zone Lobster Landings, 2010–2014
- Figure 45.—Sea Urchin Landings, 2010–2014

LIST OF TABLES

Table 1.—Summary of logbook entries with reported coordinates for each parsed dataset

ABSTRACT

This report shows commercial fisheries catch weight landings maps of directed fisheries and bycatch from the Scotian Shelf, the Bay of Fundy, and Georges Bank from NAFO Divisions 4VWX and the Canadian portions of 5Y and 5Z. Five-year composite maps (2010–2014) that aggregate catches for each map series are publicly available and included in this report. The maps aggregate catch weight (kg) per 2 x 2-minute grid cell for selected species/species groupings and gear types to identify important fishing areas. These maps may be compared with 1999–2003 landings maps in the DFO publication *The Scotian Shelf: An Atlas of Human Activities* (DFO, 2005). These maps will be used for decision making in coastal and oceans management, including mitigating human use conflicts, informing environmental emergency response operations and protocols, informing Marine Stewardship Council certification processes, planning marine protected area networks, assessing ecological risks, and monitoring interactions in coral and sponge conservation areas and Marine Protected Areas.

RÉSUMÉ

Le présent rapport illustre les cartes des débarquements (en poids) des prises ciblées et accessoires des pêches commerciales provenant de la plate-forme Néo-Écossaise, de la baie de Fundy et du banc de Georges, dans les divisions 4VWX et les parties canadiennes des divisions 5Y et 5Z de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO). Des cartes pour une période de cinq ans (2010–2014), qui combinent les prises de chaque collection de cartes, sont accessibles au public et incluses dans le présent rapport. Les cartes combinent le poids des prises (en kilogrammes) par cellule de grille de 2 x 2 minutes pour les espèces sélectionnées ou les regroupements d'espèces et pour les types d'engins, afin de déterminer les zones de pêche importantes. Ces cartes peuvent être comparées aux cartes des débarquements des années 1999–2003 dans la publication de Pêches et Océans Canada (MPO) intitulée *La plate-forme Néo-Écossaise : atlas des activités humaines* (MPO, 2005). Ces cartes seront utilisées pour la prise de décisions relatives à la gestion des côtes et des océans, y inclus l'atténuation des conflits entre les usagers; les opérations et les protocoles d'intervention en cas d'urgence environnementale; les processus de certification du Marine Stewardship Council; la planification des réseaux d'aires marines protégées; l'évaluation des risques écologiques; et la surveillance des interactions dans les zones de conservation des coraux et des éponges et les zones de protection marines.

INTRODUCTION

The fisheries catch weight landings maps in this report show commercial fisheries landings (directed fisheries and bycatch) for the Scotian Shelf, the Bay of Fundy, and Georges Bank from NAFO Divisions 4VWX and the Canadian portions of 5Y and 5Z. Landings were combined for the years 2010–2014. The data sources include three regional databases maintained by DFO Policy and Economics Branch: the Maritime Fishery Information System (MARFIS) database in Maritimes Region, as well as data from Gulf Region and Newfoundland and Labrador Region.

These maps will be used for decision making in coastal and oceans management, including mitigating human use conflicts, informing environmental emergency response operations and protocols, informing Marine Stewardship Council certification processes, planning marine protected area networks, assessing ecological risks, and monitoring compliance and threats in coral and sponge closures and Marine Protected Areas. Fisheries maps were created that aggregate landed catch weight (kg) per 2 x 2-minute grid cell for selected species/species groupings and gear types to identify important fishing areas.

Variables in the dataset included: catch latitude and longitude, species landed, live weight, date caught, NAFO unit area, DFO region, gear code and class, vessel ID, trip ID, licence ID (not available for Newfoundland and Labrador Region), and fisher ID. Erroneous data were not removed from datasets to address incorrect geo-references, e.g., sets on land that are masked by land and bottom fisheries in depths > 1,500 m. The percentage of logbook entries missing geo-references is summarized for each map series (Table 1). The percentage of records from all regions with geo-references for 2010–2014 ranged from 4.77 percent for Other Crab¹ to 100.00 percent, with an average of 91.25 percent of all logbook records being geo-referenced.

Yearly landings maps were created by plotting catch weight (kg) per 2 x 2-minute grid cell for a select list of species/species groupings and gear types. Data were divided into five classification intervals using quantile breaks where each class has an equal number of grid cells. In addition to the yearly maps that are not for public distribution, five-year composite maps that aggregate all catches for 2010–2014 for each map series are publicly available and included in this report. These maps may be compared with 1999–2003 landings maps in the DFO publication *The Scotian Shelf: An Atlas of Human Activities* (DFO, 2005).² Quantile breaks are an effective way of portraying catch weights and fishing effort information on a region-wide scale; however, these spatial depictions of human activity do not represent biological distributions of species as species' range distributions are broader than fishery footprints and management measures influence the fishing effort distribution.

METHODS

Data Processing

The first step in processing logbook data was to organize the datasets received from three regions using a consistent format. While similar information (e.g., live weight, geographic coordinates, and species landed) is reported and stored in these regional databases, the data is organized using different formats that needed to be standardized in order to merge them into a single dataset.

¹ This low percentage is due to Other Crab being reported as bycatch in the inshore lobster fishery that reports by Lobster Fishing Area and statistical grid number rather than by latitude and longitude.

² See <<http://www.inter.dfo-mpo.gc.ca/Maritimes/Oceans/OCMD/Atlas/Table-of-Contents-Fisheries>>.

Individual logbook entries typically have a reported geographic location associated with them. The three regional databases store geographic coordinates using various formats that needed to be recalculated into a single, consistent coordinate format. While Newfoundland and Labrador Region data was stored in decimal degrees, the Maritimes Region logbook entry locations were stored in degrees decimal minutes, and the Gulf Region was a combination of degrees decimal minutes and Loran-C time difference coordinates. All coordinates were converted to a decimal degrees coordinate format using a combination of documented conversion formulas (i.e., conversion of degrees decimal minutes) and a Microsoft Excel macro that was employed to convert Loran-C coordinates.

Data fields used in the MARFIS database were used as the template table structure, as the fields were the most complete. While all three regions reported several identical fields, some information stored in the MARFIS database was simply not reported in the Gulf and Newfoundland and Labrador Regions, and was therefore stored as null values (i.e., no data). The Gulf Region stored landed weight values in pounds, which needed to be converted to kilograms to be consistent with the Maritimes and Newfoundland and Labrador Regions. The three regional datasets were then imported into ArcGIS as CSV files using a WGS 1984 coordinate system.

Once incorporated into the ArcGIS environment, three more fields were added to all regional datasets to capture the source of the data (*Region* data field), and the month and year (*Month* and *Year* data fields) of the reported landing (i.e., calculated based on the date caught). In order to complete privacy screening, the VRN (Vessel Registration Number), FIN (Fisher Identification Number), and Licence ID fields were referenced to determine whether the information was reported consistently throughout the regions. As mentioned, licence IDs were not reported for the Newfoundland and Labrador Region. For the Gulf Region, FIN identifiers were provided in a separate table, which had to be linked in with the original dataset using licence IDs.

In order to store all of the various datasets, a geodatabase was created. The geodatabase was designed to store original logbook datasets for all three regions, as well as the merged datasets and gridded products. In order to avoid issues with conflicting coordinate systems, it was decided to store all data using the North American Datum (NAD) 1983 CSRS geographic coordinate system. The three regional datasets were imported into the geodatabase and re-projected into the NAD 1983 CSRS coordinate system. A single dataset was then created, which included all logbook entries from all three regions for all five years (2010–2014). This would serve as the main reference feature class from which all future data products would be created.

Using this newly created feature class, logbook entries were parsed based on species/species groupings and gear type to create individual point feature classes for use in both yearly (e.g., *gro2010*) and the five-year composite maps (e.g., *gro1014*). For select fisheries (groundfish and scallop), quarterly datasets were produced (e.g., *scxQ1 1014* feature class represents all scallop landings in the first quarter from 2010–2014). For all reported landings, there were a varying proportion of entries for a given fishery that did not report coordinate locations. While these were not removed from the point feature classes, they could not be incorporated into the aggregated grids. Table 1 shows analysis results that determined the percentage of logbook entries with geographic coordinates reported for each species/species grouping. As the numbers indicate, reported coordinates vary widely across different fisheries. Once all parsed files were created, the plotted landings needed to be aggregated into grid cells.

Table 1.—Summary of logbook entries with reported coordinates for each parsed dataset. Logbook entries per species include all gear types. (* = Inter-regionally managed fishery)

Fishery	File Name	Total Logbook Entries	Total Entries Missing Coordinates	% With Coordinates
Monkfish	ang104	23,158	280	98.79
Bluefin Tuna*	bft1014	9,418	1,229	86.95
Groundfish (Bottom Trawl)	BTgro1014	517,267	462	99.91
Cod, Haddock, Pollock	chp1014	310,284	3,343	98.92
Cod	cod1014	95,576	1,608	98.32
Snow Crab	crq1014	18,841	429	97.72
Dogfish	dgx1014	653	9	98.62
Groundfish (Longline)	DLLgro1014	118,026	5,650	95.21
Flatfish	flo1014	77,202	775	99.00
Greenland Halibut	ghl1014	4,564	85	98.14
Groundfish (Gillnet)	GNgro1014	20,852	2,323	88.86
Groundfish	gro1014	659,474	8,879	98.65
Hagfish	hag1014	1,547	35	97.74
Atlantic Halibut	hal1014	80,883	10,219	87.37
Herring	her1014	25,964	2,683	89.67
Red Hake	hkr1014	15,620	23	99.85
Silver Hake	hks1014	15,856	23	99.85
White Hake	hkw1014	46,781	901	98.07
Lobster (Grey Zone)	lbaGZ1014	5,180	378	92.70
Lobster (Offshore)	lbaOS1014	23,647	153	99.35
Large Pelagics	lpl1014	26,679	445	98.33
Mackerel	mac1014	5,795	1,811	68.75
Offshore Clam	ocl1014	33,657	0	100.00
Crab (Other)	ocr1014	60,736	57,839	4.77
Tuna (Other)	otn1014	8,246	157	98.10
Shark (Porbeagle, Mako, Blue)	pmb1014	3,987	121	96.97
Redfish*	red1014	77,214	10,447	86.47
Sculpin	scu1014	15,079	423	97.19
Scallop*	scx1014	153,690	3,249	97.89
Sea Cucumber	sec1014	3,020	13	99.57
Shrimp	shr1014	15,920	245	98.46
Skate	ska1014	3,946	83	97.90
Squid	squ1014	7,728	50	99.35
Swordfish	swo1014	14,531	177	98.78
Sea Urchin	urc1014	7,531	6,418	14.78
Cusk	usk1014	26,997	880	96.74
Wolffish	wlf1014	7,918	131	98.35

Data Aggregation

Data aggregation methods were used to depict fishing intensity and distribution for a public audience. Aggregation methods group the data to ensure confidentiality and illustrate spatial patterns and trends. The simplest and most common method to aggregate fisheries data involves binning spatial data into grid cells (see hypothetical example, Figure 1). Grids are an array of cells of equal size, with each cell containing a single attribute value. Grid cell size is determined based on considerations of the map scale (e.g., region-wide maps may bin the data into larger grid cells than maps focused on a smaller geographic area), and data resolution (e.g., if catch coordinates are rounded to the nearest minute, grid cells should not be less than 1 x 1 minute). Grid cell size may also need to be increased to address confidentiality concerns. Two-minute grid cells were used for all map products displayed in this report, allowing comparison with maps produced previously, e.g., DFO, 2005. At 45° North latitude, a 2-minute grid cell is approximately 2.6 km (east-west) by 3.7 km (north-south), or approximately 10 km².

Offsetting grid cell boundaries were used so that data are captured within the cells rather than on the boundary lines. For fisheries where coordinates are rounded to the nearest minute, offsetting grid cells by half-minute intervals means that coordinates are completely contained within grid cells rather than aligning with the grid lines (see Figure 1). All the catch values within each cell are summed to produce a single value per grid cell.

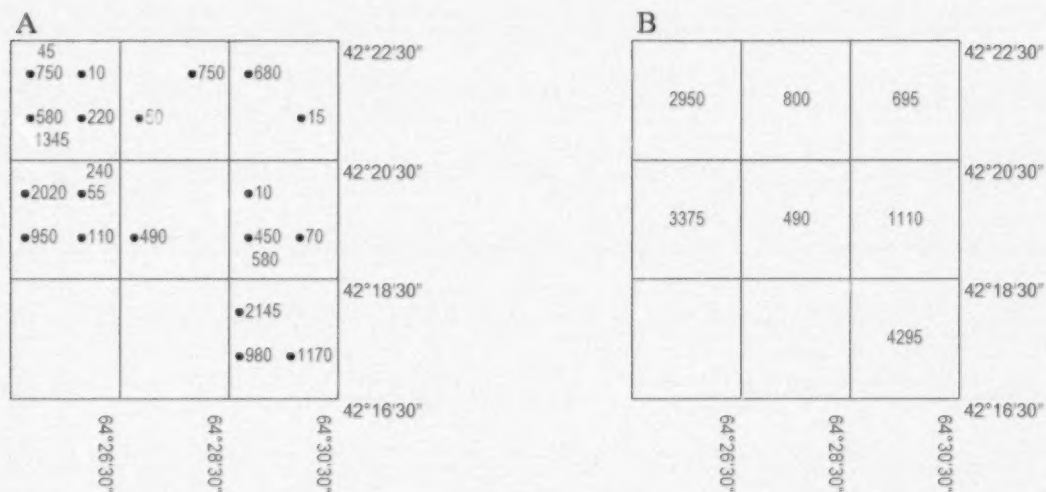


Figure 1.—Aggregating fisheries catch weight landings within 2 x 2 minute grid cells. A) Catch weights (kg) reported at specific geographic coordinates, rounded to the nearest minute. Given this level of reporting resolution, grid cells were offset by half-minute intervals so that each catch location was completely contained within a single cell. In this example, catches may be recorded at four possible locations within each grid cell. B) Catch weights (kg) are summed to provide a single value for each grid cell. (Source: DFO, 2005, p. 11).

Privacy Screening

To comply with the Government of Canada's privacy policy on vessel-specific fishing locations (Treasury Board Directive, 2010), privacy assessments were conducted on all map layers to

identify NAFO unit areas containing data from less than five vessel IDs, licence IDs and fisher IDs, known as the "Rule of Five." If this threshold was not met, confidential information such as catch weight and fishing effort locations have been withheld from these unit areas to protect the identity or activity of individual vessels or companies. In some cases consents were sought from licence holders to publicly release map products. NAFO unit areas failing to meet the privacy screening threshold are symbolized by grey-shaded hatching in catch weight and effort map products and are labeled as privacy-screened areas.

In order to prepare catch weight data for privacy assessments against the Rule of Five, a new species-specific feature dataset was created containing all species landings files in a privacy screening geodatabase. Counts were calculated of unique occurrences of all three variables (i.e., vessel ID, licence ID and fisher ID) per NAFO unit area. Statistics were calculated to determine if all three variables passed the Rule of Five in each unit area for each species-specific feature dataset. Tables were created of unique ID counts and pass / fail designations were assigned per NAFO unit area for each species-specific feature dataset. Adjustments were made to the privacy assessments of inter-regional maps for bluefin tuna, Atlantic halibut, scallop, and redfish to account for the lack of licence IDs in data from Newfoundland and Labrador Region.

FISHERIES DESCRIPTIONS AND CATCH WEIGHT LANDINGS MAPS

Fisheries are managed using various measures, e.g., quotas, gear restrictions, seasons, area closures, size restrictions, and other characteristics of the targeted species. Management measures outlined in the following brief species/species grouping descriptions are incomplete and may change at any time. Updated descriptions of current fisheries management measures and practices are available in the species-specific integrated fisheries management plans (IFMPs), conservation harvesting plans (CHPs), fisheries licence conditions, and variation orders available from DFO Resource Management.³ The following species descriptions include, where applicable, the status of Species at Risk Act (SARA) designations,⁴ Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessments,⁵ and Marine Stewardship Council (MSC) fishery sustainability certifications.⁶

DFO monitors commercial fish stocks on the Scotian Shelf and publishes stock status reports on individual species available from the Canadian Science Advisory Secretariat (CSAS).⁷ The State of the Scotian Shelf theme paper, *Fish Stock Status and Commercial Fisheries* (O'Boyle, 2012), provides information on key fish stocks, harvest control rules, and trends in commercial fisheries on the Scotian Shelf.

³ See IFMPs and Fishery Openings and Closures online: <<http://dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/index-eng.htm>> and <<http://www.inter.dfo-mpo.gc.ca/Maritimes/Commercial-Fisheries/>>.

⁴ See <<http://www.sararegistry.gc.ca/>>.

⁵ See <<http://www.cosewic.gc.ca/>>.

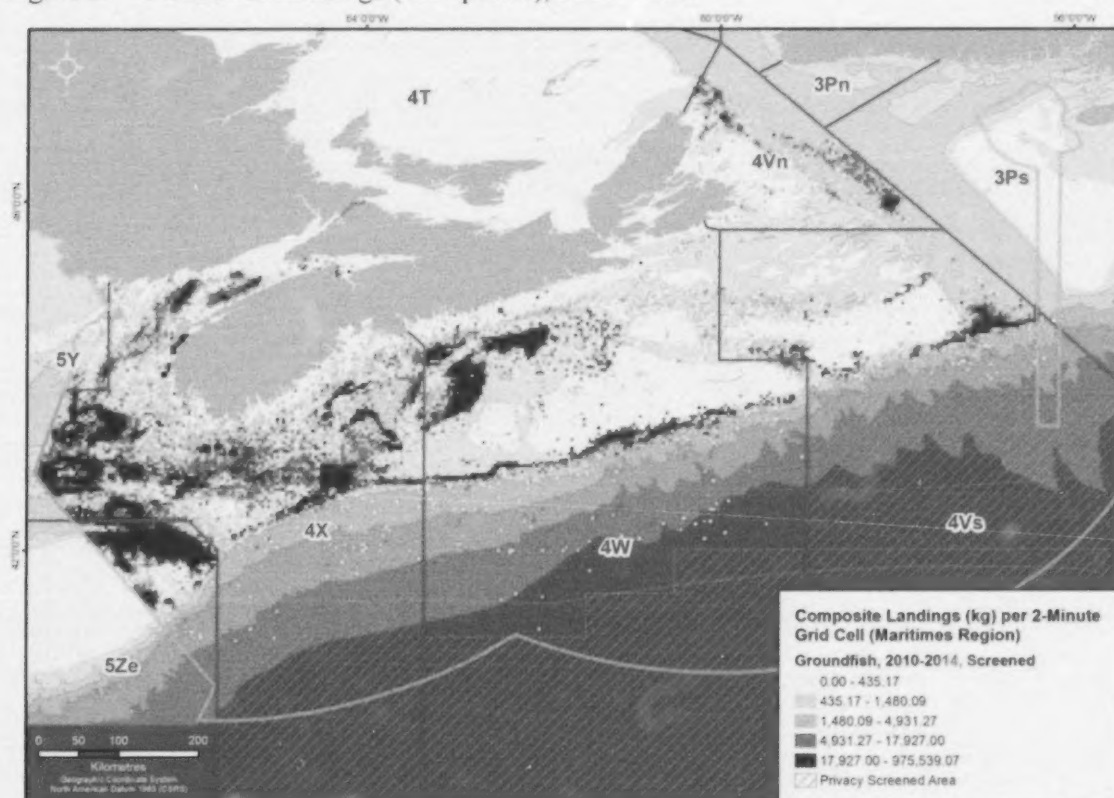
⁶ See <<http://www.msc.org/>>.

⁷ See DFO CSAS publications online: <<http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm>>.

Groundfish (Figure 2)

Figure 2 shows all species groundfish landings, including Atlantic cod, haddock, pollock, flatfishes (e.g., yellowtail, witch and winter flounders, and American plaice), silver hake, and redfish, and lesser known species such as white hake, red hake, cusk, skate, monkfish, and sculpin. The map in Figure 2 shows directed groundfish catch and bycatch in other fisheries. Most groundfish are caught by mobile trawl gear and longline vessels.

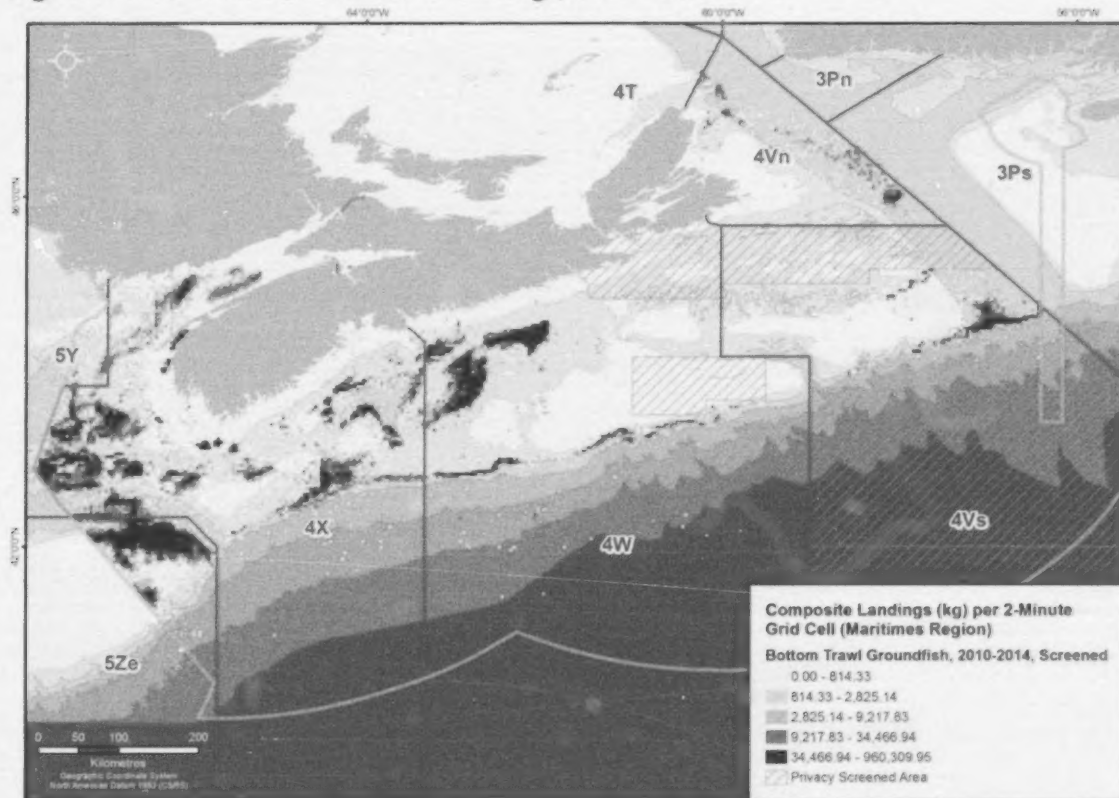
Figure 2.—Groundfish Landings (All Species), 2010–2014



Groundfish Bottom Trawl (Figure 3)

Figure 3 shows groundfish landings from otter trawl gear. Otter trawls are used across the Scotian Shelf, with the relative lack of fishing activity on the eastern Scotian Shelf due to the 1992 cod and haddock moratorium. Otter trawlers have higher landings in mid-shelf basins due to the silver hake fishery that uses trawl gear in that area. Groundfish landings include Atlantic cod, haddock, pollock, cusk, flatfish, hagfish, halibut, monkfish, redfish, red hake, silver hake, white hake, skate, squid, and wolffish.

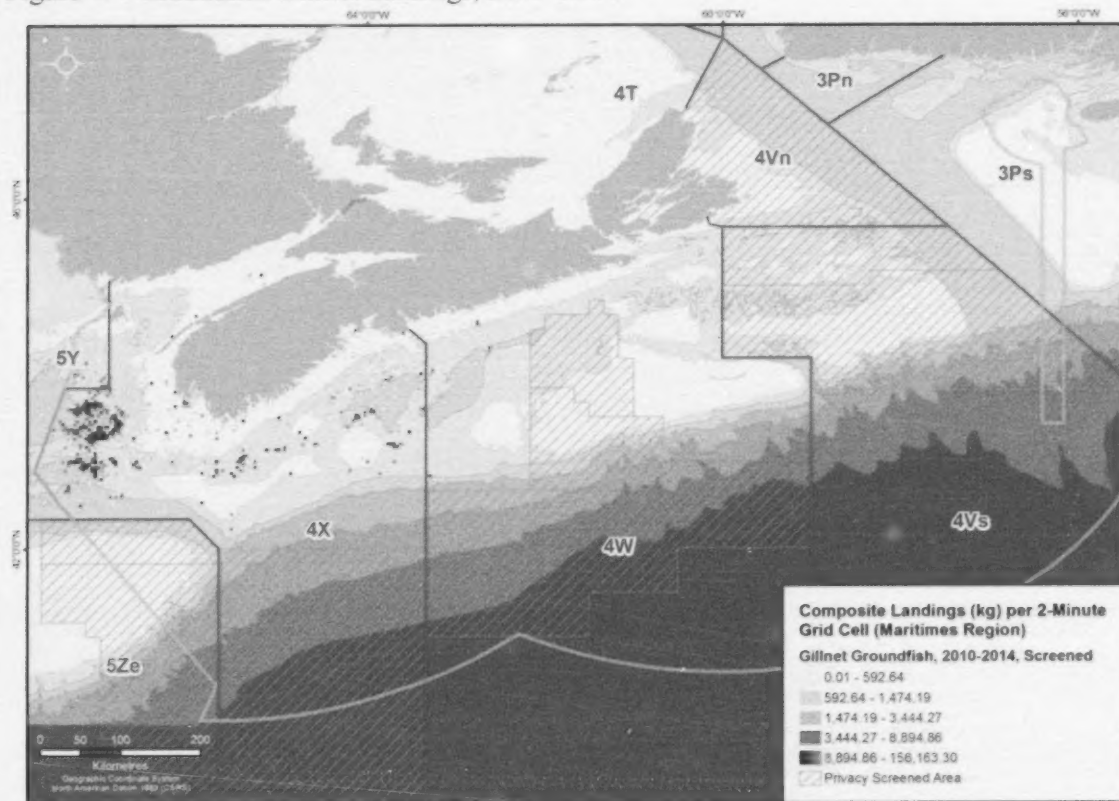
Figure 3.—Groundfish Bottom Trawl Landings, 2010–2014



Groundfish Gillnet (Figure 4)

Gillnet landings in Figure 4 are from the Scotian Shelf off southwestern Nova Scotia and in the Gulf of Maine. Gillnet landings are scattered, with few areas reporting landings. Many areas do have relatively high landings, suggesting effort is patchily distributed based on important areas.

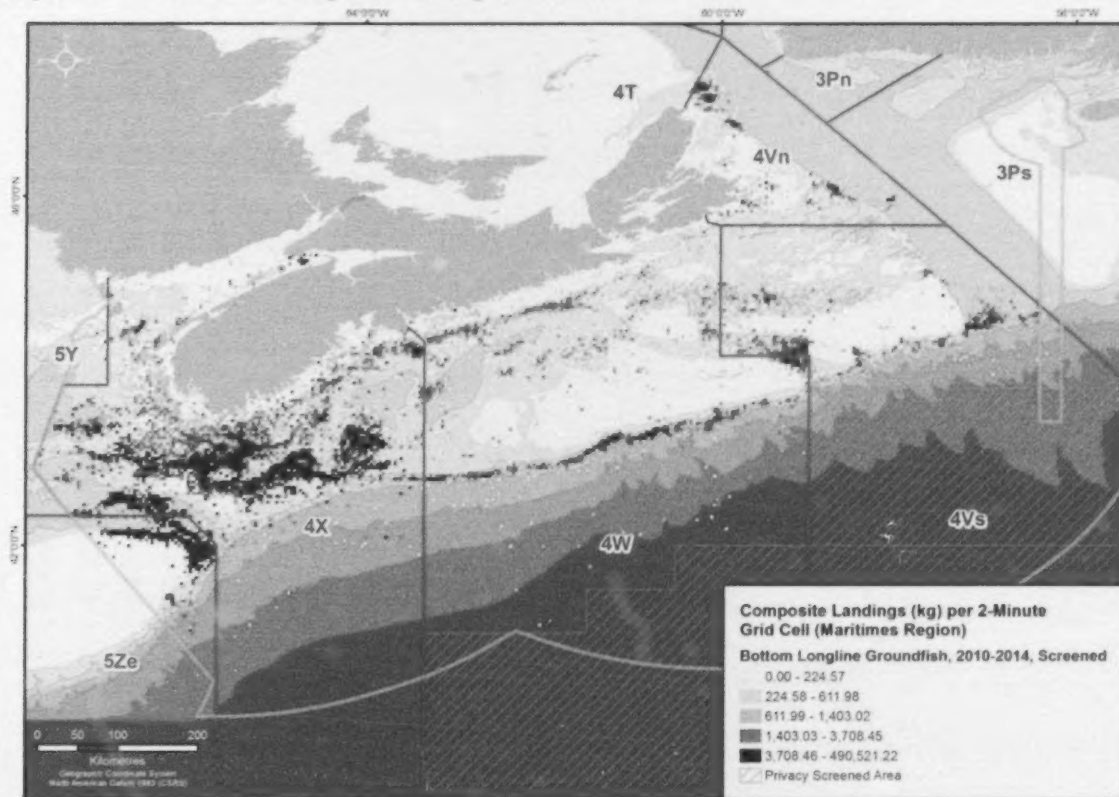
Figure 4.—Groundfish Gillnet Landings, 2010–2014



Groundfish Bottom Longline (Figure 5)

Figure 5 shows groundfish landings from demersal longline gear. While overlap exists in the areas used by the different groundfish gears, differences are evident. Longline gear is used across the Scotian Shelf, with the relative lack of fishing activity on the eastern Scotian Shelf due to the Atlantic cod and haddock moratorium in NAFO areas 4VW. Longliners target Atlantic halibut along the shelf edge and deeper channels, with fewer landings from the mid-shelf basins.

Figure 5.—Groundfish Longline Landings, 2010–2014



Seasonal Groundfish Q1–Q4 (Figures 6 to 10)

Groundfish are caught during all seasons of the year (see Figures 6 to 9), with different areas being more or less important depending on the season. Seasonal patterns reflect seasonal fish migrations, management regulations, patterns of activity in other fisheries, and weather and climatic conditions. Some groundfish fisheries run year-round, with higher catches occurring at certain times of the year. From July to September, fishing activity is relatively widespread, particularly on the western Scotian Shelf and in the Bay of Fundy. Georges Bank is closed from the first Sunday in February until June 1 and an active winter fishery occurs in January.

Figure 6.—Seasonal Groundfish Landings, January–March, 2010–2014

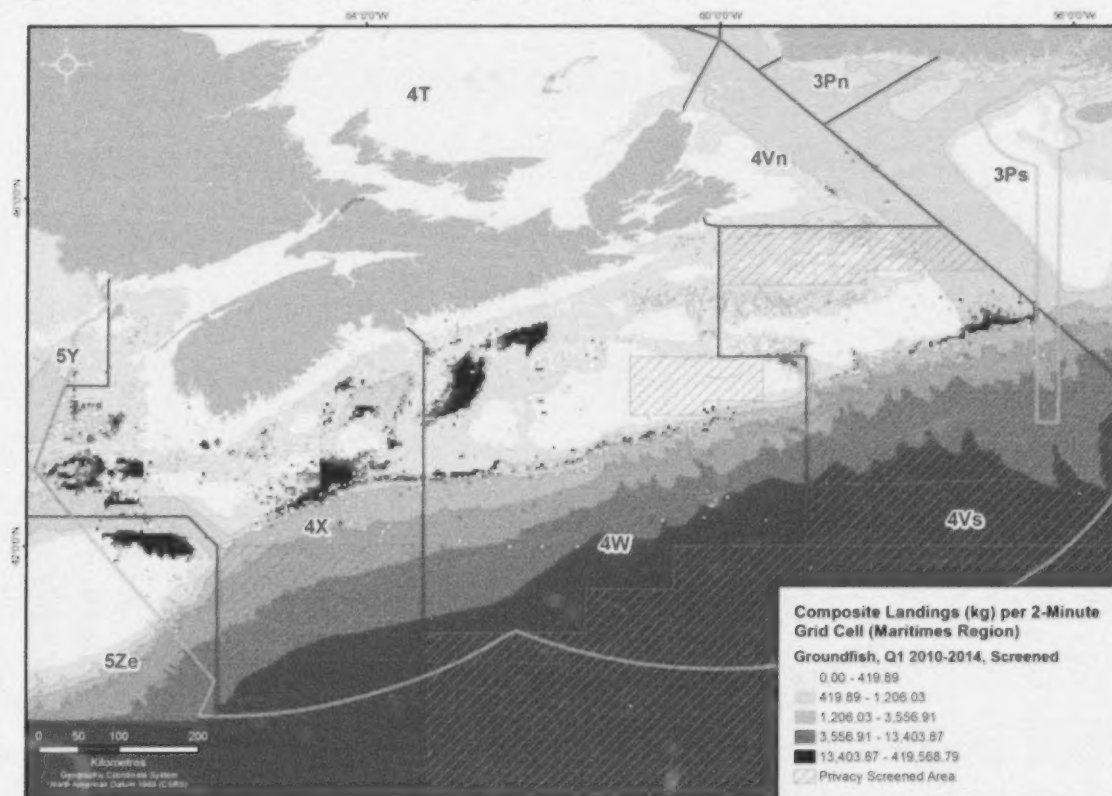


Figure 7.—Seasonal Groundfish Landings, April–June, 2010–2014

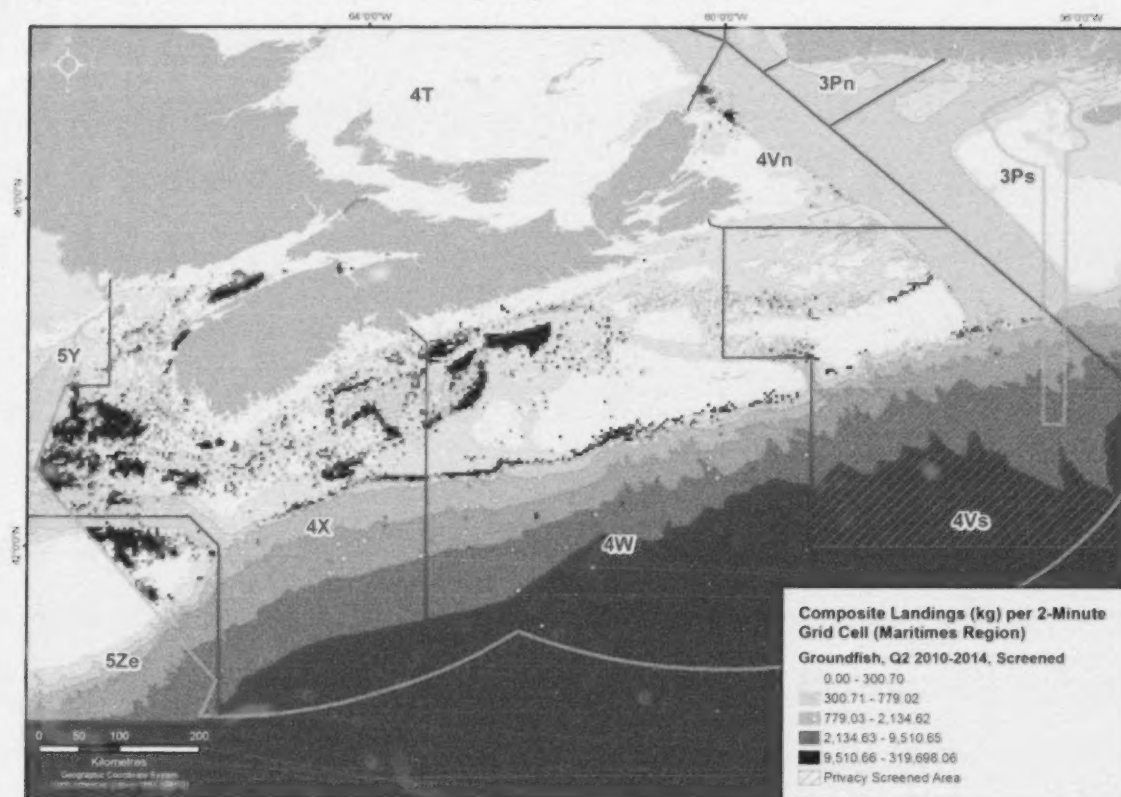


Figure 8.—Seasonal Groundfish Landings, July–September, 2010–2014

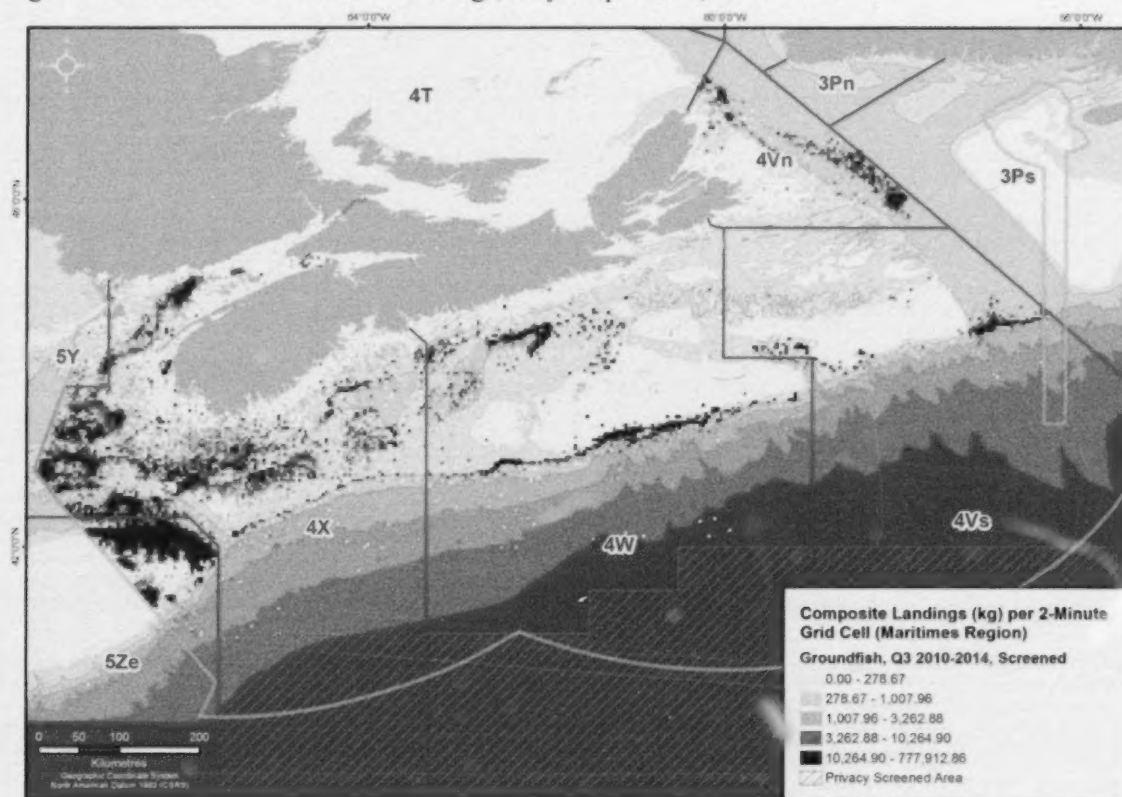
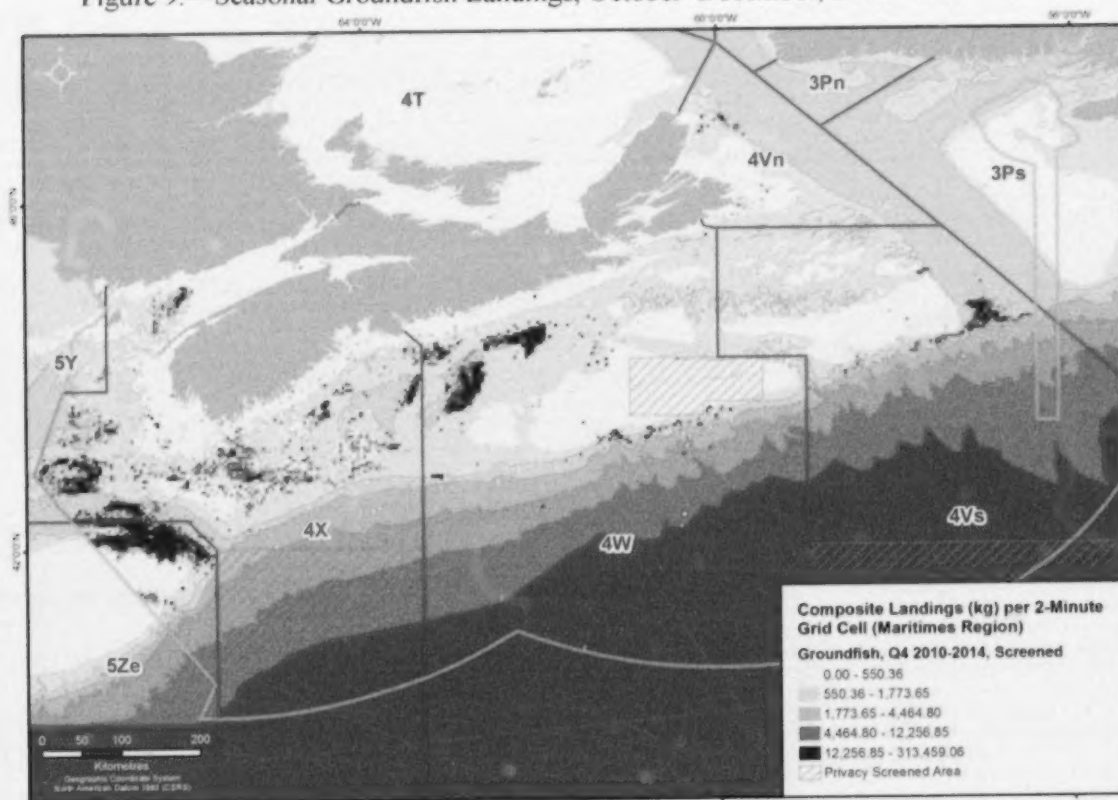


Figure 9.—Seasonal Groundfish Landings, October–December, 2010–2014



Atlantic Cod (Figure 10)

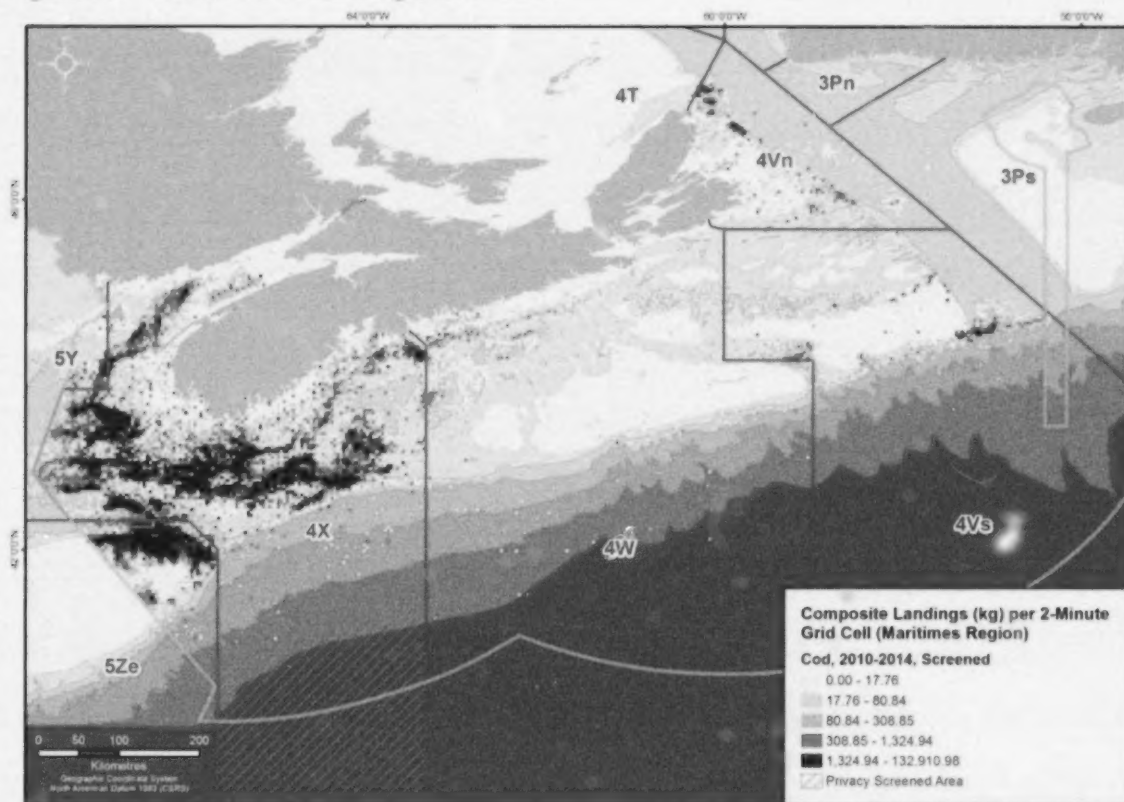
SARA Status: No Status.

COSEWIC Status: Southern Population, Endangered.

MSC Status: Not in MSC program.

Figure 10 shows Atlantic cod (*Gadus morhua*) catch as part of a larger multi-species groundfish fishery directing for Atlantic cod, haddock, and pollock using fixed and mobile gear. Landings have declined in the last three decades in areas that have experienced changes in ecosystem trophic structure. With directed fisheries for Atlantic cod and haddock closed on the eastern Scotian Shelf (NAFO Divisions 4VW), landings of Atlantic cod, haddock and pollock on the western Scotian Shelf (4X and 5Y) are much higher than on the eastern Scotian Shelf. Bycatch and minimum size limits are in place for Atlantic cod.

Figure 10.—Atlantic Cod Landings, 2010–2014



Atlantic Cod, Haddock, and Pollock (Figure 11)

SARA Status: No Status.

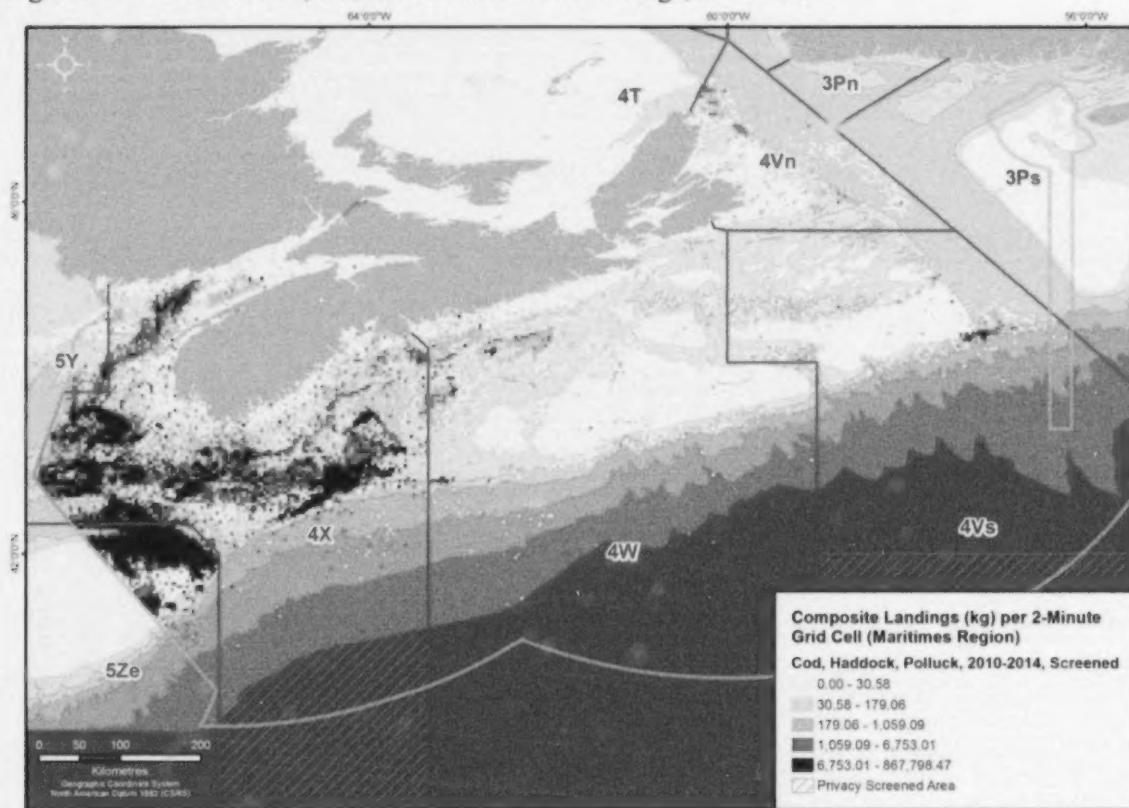
COSEWIC Status: Atlantic Cod southern population, Endangered.

MSC Status: Scotia-Fundy haddock certified as sustainable in October 2010.

Atlantic Cod, haddock (*Melanogrammus aeglefinus*) and pollock (*Pollachius pollachius*) have been the dominant groundfish species landed off Nova Scotia. Landings of these species have declined over the last three decades as other species became abundant. With directed fisheries for Atlantic cod and haddock closed on the eastern Scotian Shelf (NAFO Divisions 4VW), Atlantic cod, haddock, and pollock landings on the western Scotian Shelf are much higher than on the eastern Scotian Shelf. The pollock fishery on the eastern Scotian Shelf remains open; however, little effort for pollock is made in that area due to closures for the other two species. In many parts of the region, fishers catch these three species together.

Atlantic cod, haddock, and pollock fisheries occur mainly on the Scotian Shelf banks and in the Bay of Fundy (Figure 11). The fishery is conducted using otter trawls, longlines, and gillnets. Parts of Browns and Georges Banks are closed seasonally to protect spawning haddock. In NAFO 4W, the Haddock Box on Western and Emerald Banks has been closed to groundfish fishing using mobile gear since 1987 and to all groundfish gear since 1993. The Haddock Box closure is to protect a nursery area for juvenile haddock.

Figure 11.—Atlantic Cod, Haddock and Pollock Landings, 2010–2014



Flatfish (Figure 12)

SARA Status: American Plaice, No Status.

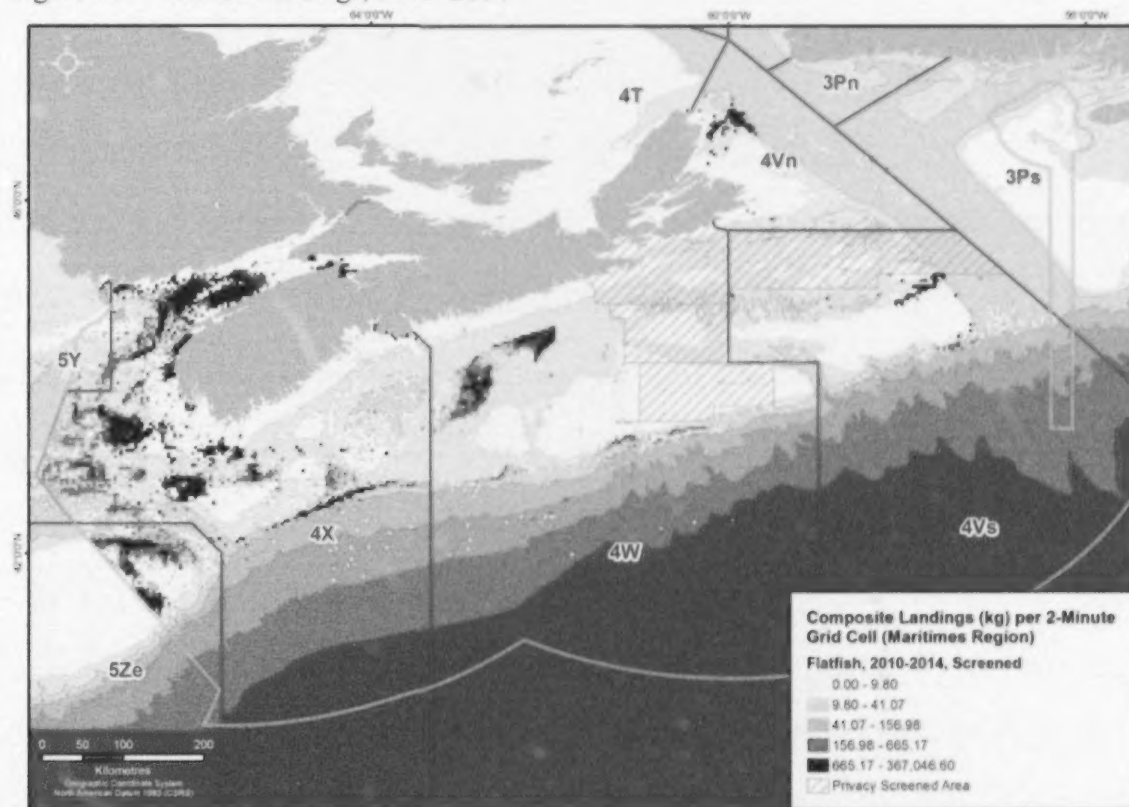
COSEWIC Status: American Plaice, Threatened.

MSC Status: Not in MSC program.

Several flatfish species are managed under the 4X5Y total allowable catch (TAC), including yellowtail flounder (*Limanda ferruginea*), American plaice (*Hippoglossoides platessoides*), winter flounder (*Pseudopleuronectes americanus*), and witch flounder (grey sole) (*Glyptocephalus cynoglossus*). In 4VW, the species are American plaice, yellowtail flounder, and witch flounder. On Georges Bank (5Z), yellowtail flounder is the primary species caught and this stock is managed separately.

The flatfish TAC in 4VWX and 5Y has been combined because historically landings of different flatfish species were not always reported separately. Figure 12 shows landings from the four species mentioned above, as well as from unspecified flounder. In general, the shelf banks are important for the yellowtail and plaice fisheries, while deeper areas are more important for witch flounder. Winter flounder is uncommon on the eastern Scotian Shelf, and on the western Scotian Shelf it is concentrated in only a few areas. Historically, the eastern Scotian Shelf (4VW) was more important than the western Scotian Shelf (4X), not including Georges Bank, for yellowtail and plaice fisheries. However, a general reduction in the groundfish fishery on the eastern Scotian Shelf and a declining abundance of flatfish resulted in low catches in the east.

Figure 12.—Flatfish Landings, 2010–2014



Atlantic Halibut (Figure 13)

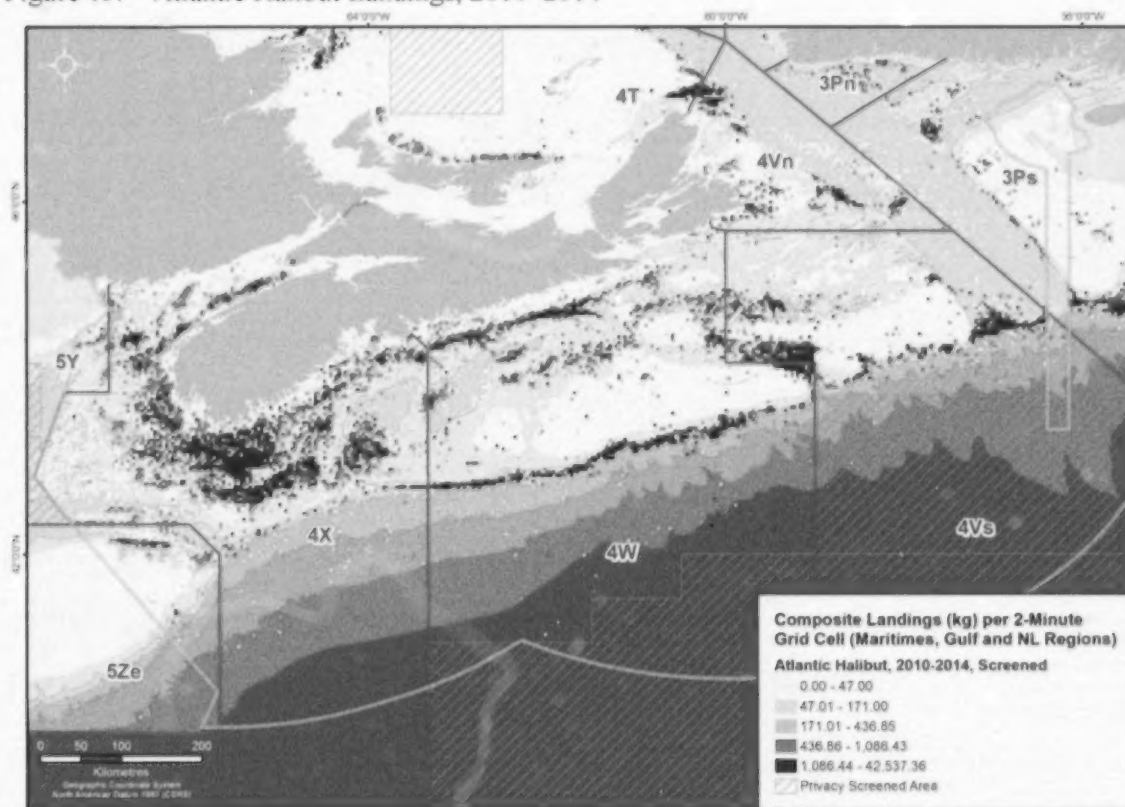
SARA Status: Not at Risk

COSEWIC Status: Not at Risk

MSC Status: Certified as sustainable in May 2013.

Atlantic halibut (*Hippoglossus hippoglossus*) is the most valuable groundfish species in Atlantic Canada. The Atlantic halibut fishery was unregulated until 1988, at which time a total allowable catch (TAC) was implemented for the Scotian Shelf and southern Grand Banks management unit (3NOPs-4VWX5Zc). In 1994, a minimum legal size limit of 81 cm was adopted. On the Scotian Shelf and the southern Grand Banks most of the landed halibut is from a directed longline halibut fishery. Halibut is also landed by other longline, trawl, gillnet and handline fisheries. Figure 13 shows halibut is primarily caught in deep channels and along the shelf edge, but in southwest Nova Scotia (4X) halibut catch is broadly distributed. There are restrictions on fishing halibut in the Haddock Box nursery area and in the Gully Marine Protected Area. As well, halibut fishing is not permitted in the Lophelia Coral Conservation Area and the Northeast Channel Coral Conservation Area. There are also seasonal closures in other areas, as well as trip limits and bycatch restrictions. The TAC in 2014 was 2,563 tonnes (den Heyer et al., 2015).

Figure 13.—Atlantic Halibut Landings, 2010–2014



Greenland Halibut (Figure 14)

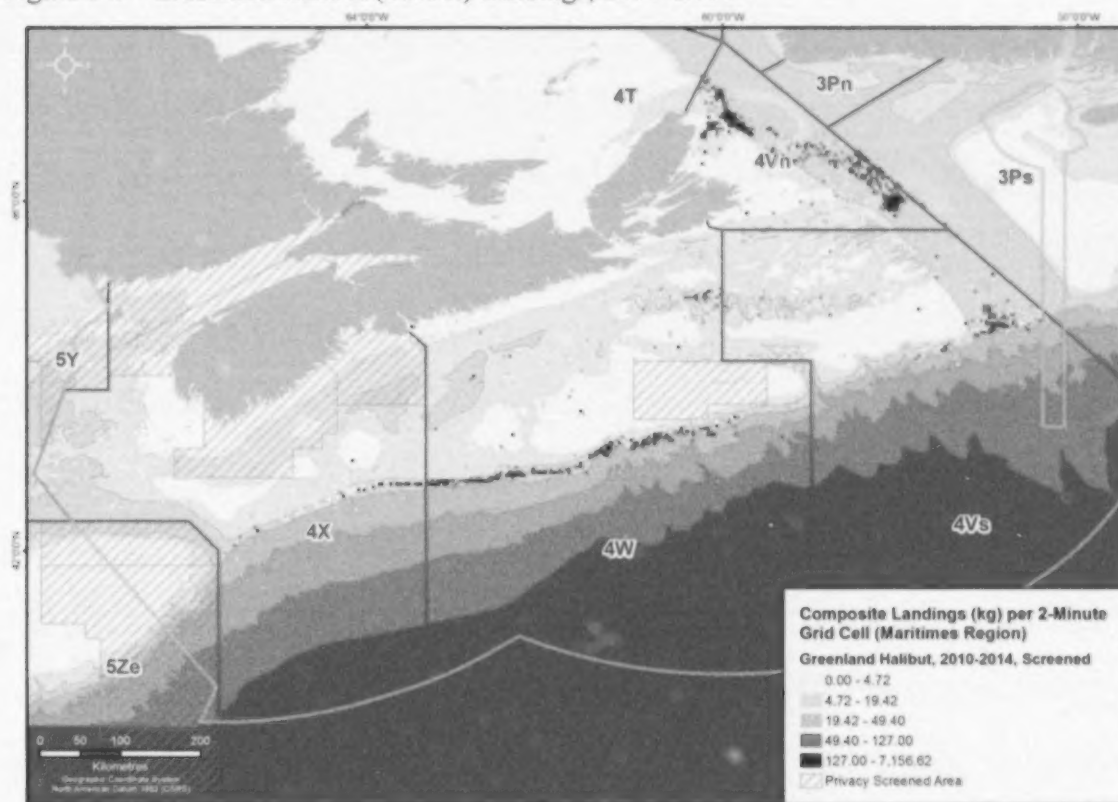
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Greenland halibut (*Reinhardtius hippoglossoides*) (also called turbot) are highly migratory in the Northwest Atlantic and are generally found north of the Scotian Shelf in the Gulf of St. Lawrence, although they occur as far south as the Gulf of Maine. The occurrence of Greenland halibut on the eastern Scotian Shelf may be an extension of the stock inhabiting the Gulf of St. Lawrence. Figure 14 shows Greenland halibut are caught in deeper waters especially near the Stone Fence and along the Laurentian Channel and Scotian Shelf slope. There is no directed fishery for Greenland halibut as they are only caught as bycatch.

Figure 14.—Greenland Halibut (Turbot) Landings, 2010–2014



Hagfish (Figure 15)

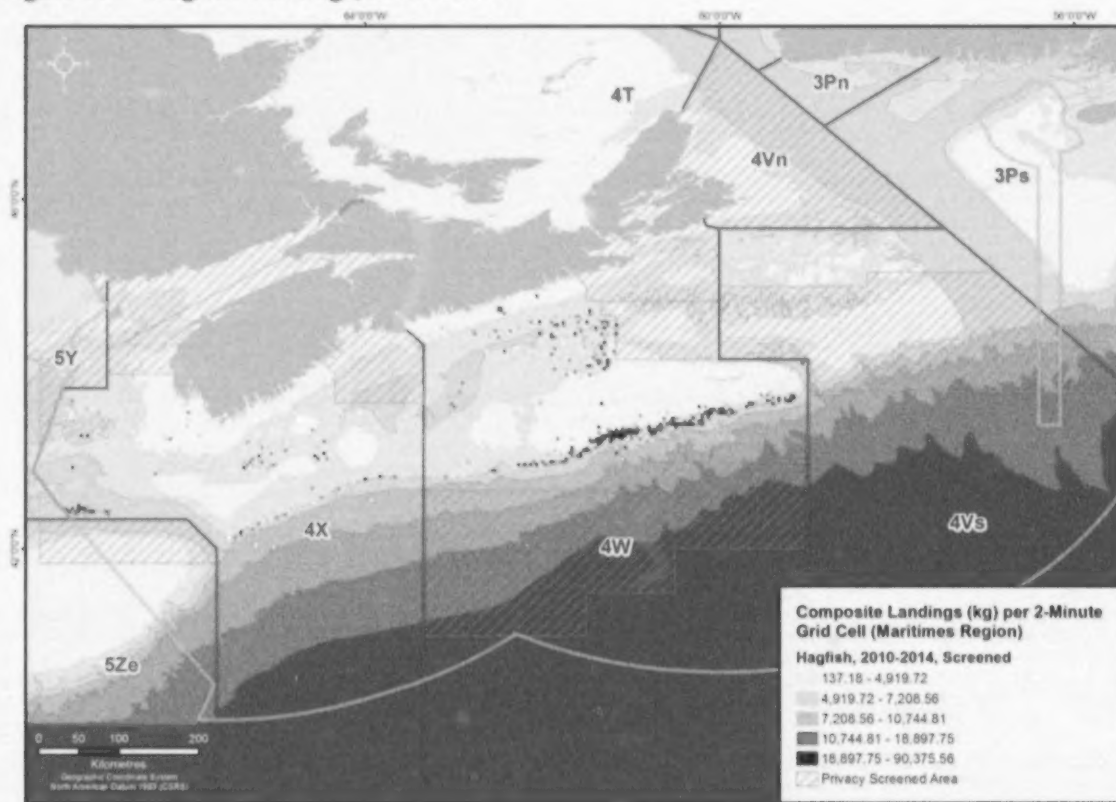
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Atlantic hagfish (*Myxine glutinosa*) is widely distributed throughout the Northwest Atlantic. There has been a directed fishery for hagfish off Nova Scotia since the late 1980s. The hagfish trap fishery consists of modified plastic barrels deployed in strings of c. 30–35 barrels, with a maximum of 450 traps per licence. The fishing season runs from April 15 to October 15. The fishery is closed in coral and sponge conservation areas, the Gully Marine Protected Area, the Haddock Box, and is subject to two seasonal groundfish closures on Georges and Browns Banks from March 1 to May 31 (DFO, 2016a). Figure 15 shows the landings distribution along the Scotian Shelf edge, in Roseway Basin, and north of Georges Bank. The low number of participants ($n = 7$) in the Scotian Shelf fishery results in many NAFO unit areas being privacy screened. Hagfish fishing in the Bay of Fundy only occurs south of the mid-Bay line.

Figure 15.—Hagfish Landings, 2010–2014



Cusk (Figure 16)

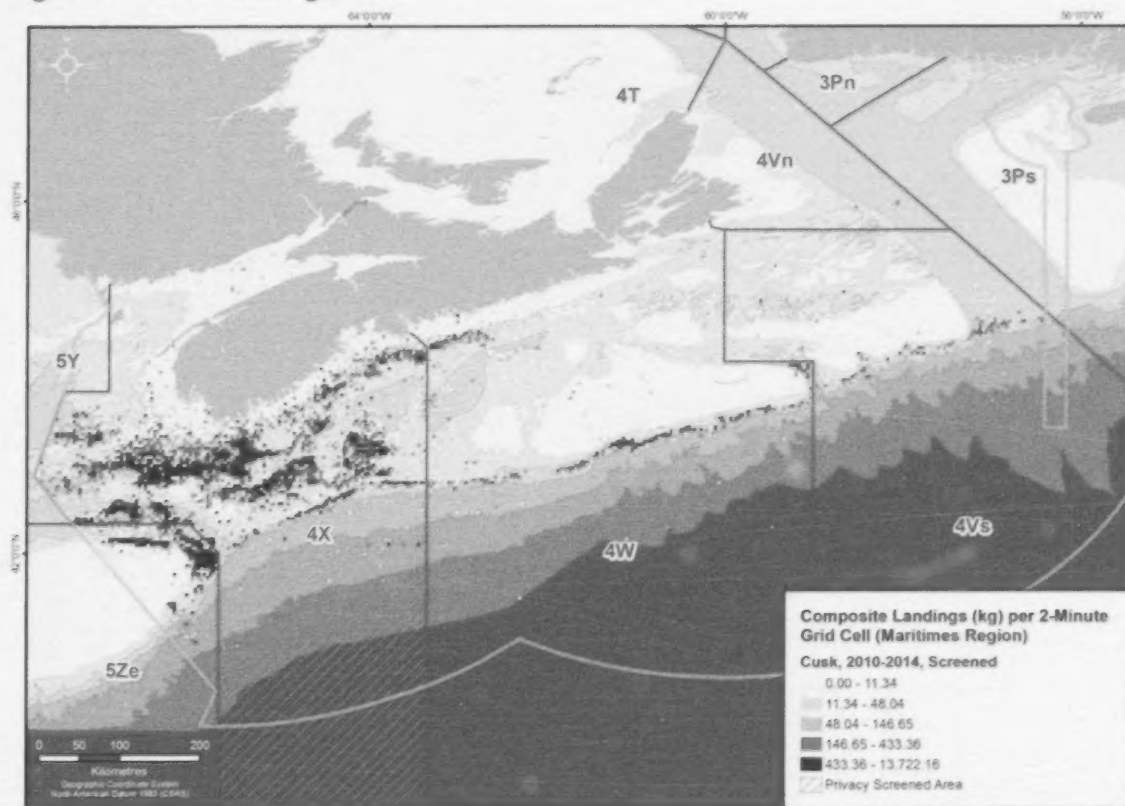
SARA Status: No Status.

COSEWIC Status: Endangered.

MSC Status: Not in MSC program.

Cusk (*Brosme brosme*) is a non-target bycatch species incidentally harvested in the multi-species groundfish fishery (Figure 16). Cusk are most commonly caught in the Gulf of Maine, western Scotian Shelf, and along the Scotian Shelf edge to Banquereau on longline and in bottom trawl gear. Cusk range from Cape Cod to Labrador, but is rare in the Gulf of St. Lawrence and inner Bay of Fundy. Cusk are also caught in lobster and crab trap fisheries. Post-capture survival of cusk is zero percent as they evert their stomach through the mouth upon surfacing. Bycatch limits are in place so that catch of non-quota species are not to exceed 10 percent of all directed groundfish combined and a cap on the total annual catch of cusk is also in place. Community and fleet-level caps exist for cusk, and DFO prohibits cusk retention once a group reaches their cap.

Figure 16.—Cusk Landings, 2010–2014



Dogfish (Figure 17)

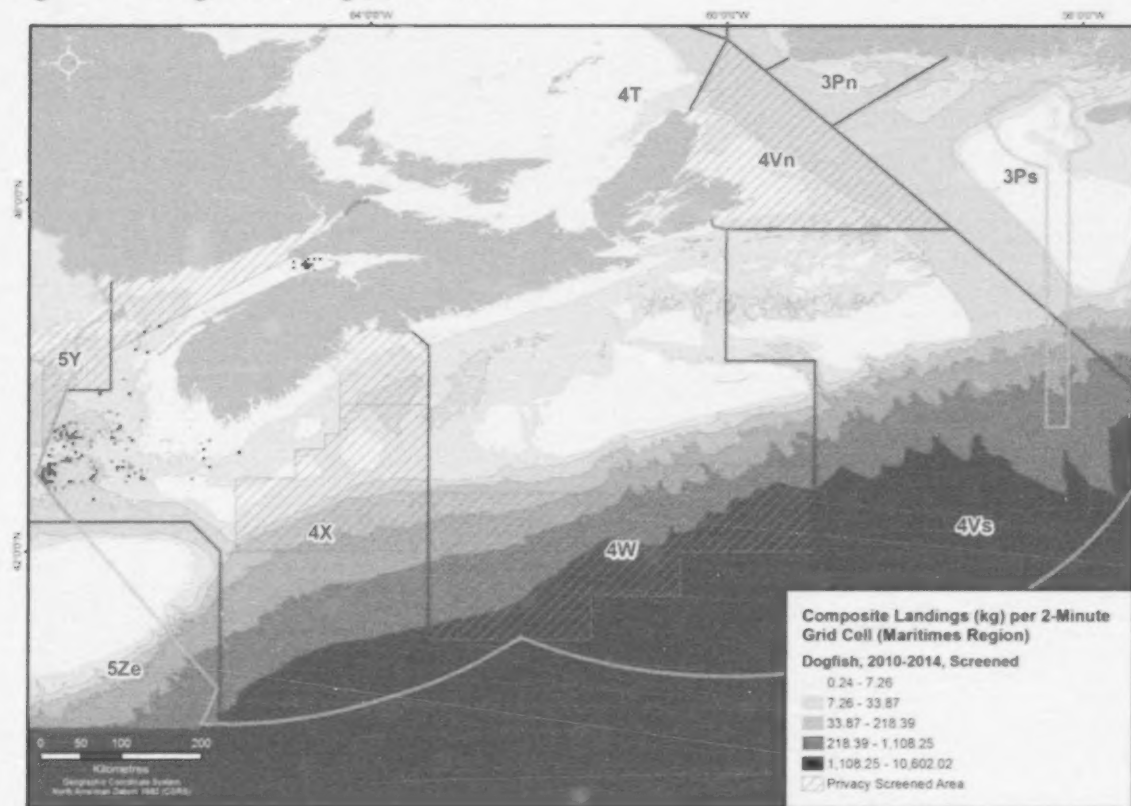
SARA Status: No Status.

COSEWIC Status: Spiny Dogfish (*Squalus acanthias*), Atlantic population, Special Concern.

MSC Status: Not in MSC program.

Spiny dogfish (*Squalus acanthias*) and black dogfish (*Centroscyllium fabricii*) are landed as bycatch in the multi-species groundfish fishery (Figure 17). Directing for dogfish is only permitted with longline gear. In other fisheries, the bycatch limit is no more than 10 percent. In 2016, a TAC of 4,000 tonnes was in place for the fixed gear <45-foot fleet and another 4,000 tonnes were available to cover landings and discards in other fleets and regions. Dogfish landings averaged 600 tonnes per year from 2010 to 2014, and have been lower since then.

Figure 17.—Dogfish Landings, 2010–2014



Redfish (Figure 18)

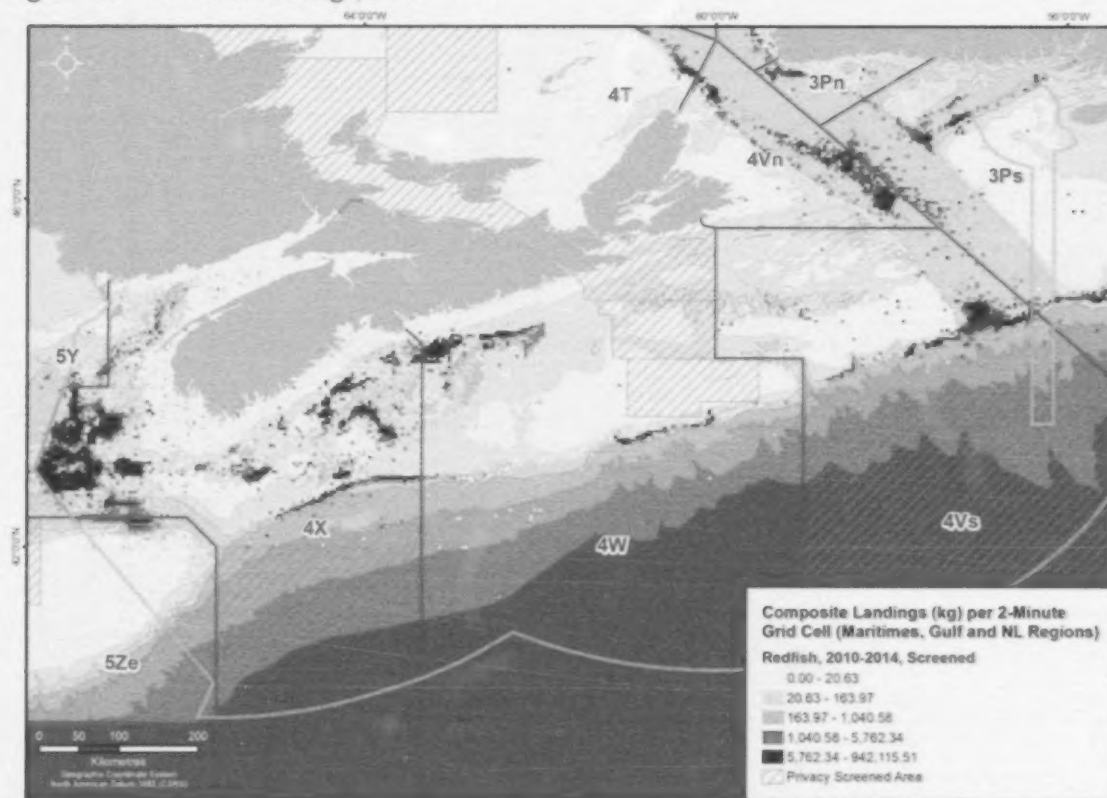
SARA Status: No Status.

COSEWIC Status: Acadian redfish (Atlantic population) and deep-water redfish (Gulf of St. Lawrence and Laurentian Channel population), Threatened.

MSC Status: Not in MSC program.

Three species of redfish are found in the Northwest Atlantic, namely *Sebastes mentella* and *S. fasciatus* that are dominant in commercial fisheries, and the less abundant *S. marinus*. Redfish (*S. fasciatus* and *S. mentella*) are targeted with otter trawls along the shelf edge, in the Northeast and Laurentian Channels, and in other deep areas of the Scotian Shelf and Bay of Fundy (Figure 18). Since the 2010 stock assessment, redfish managed as Units 1 and 2 (Gulf of St. Lawrence and Laurentian Channel, respectively) are assessed as one stock for each species, i.e., one *S. mentella* stock for Units 1 and 2 combined, and one *S. fasciatus* stock for Units 1 and 2 combined. The Scotian Shelf Unit 3 redfish stock includes portions of 4WX and 5Y. The fishery uses small mesh gear and many management restrictions prevent bycatch of small fish from other species. A special management area in Unit 3 is the Bowtie, which is closed to small mesh gear (square mesh less than 130 mm) to protect small redfish. Small mesh gear is also not permitted in waters shallower than 50 fathoms (91 metres), in the Bay of Fundy north of 43°30', and in NAFO Area 5Y and 5Z. The Browns Bank haddock spawning area has an extended redfish closure from January 1 to June 30.

Figure 18.—Redfish Landings, 2010–2014



Red Hake (Figure 19)

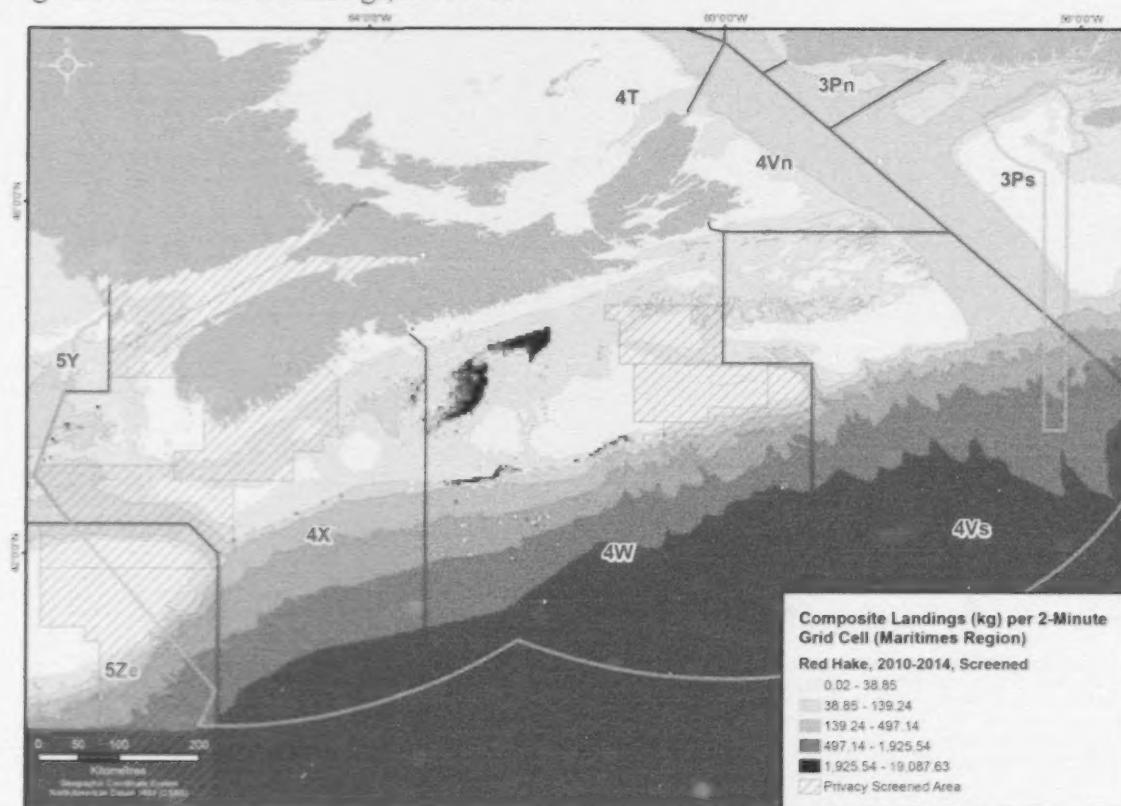
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Red hake (*Urophycis chuss*) are distributed in the Northwest Atlantic from North Carolina to southern Nova Scotia, straying into the Gulf of St. Lawrence. Throughout the spring and summer, they migrate into more shallow waters to spawn. During winter, they tend to move to deeper waters offshore in the Gulf of Maine and along southern New England and Georges Bank. Red hake are primarily landed as bycatch in the silver hake fishery that occurs on the central Scotian Shelf and in other bottom trawl fisheries (Figure 19).

Figure 19.—Red Hake Landings, 2010–2014



Silver Hake (Figure 20)

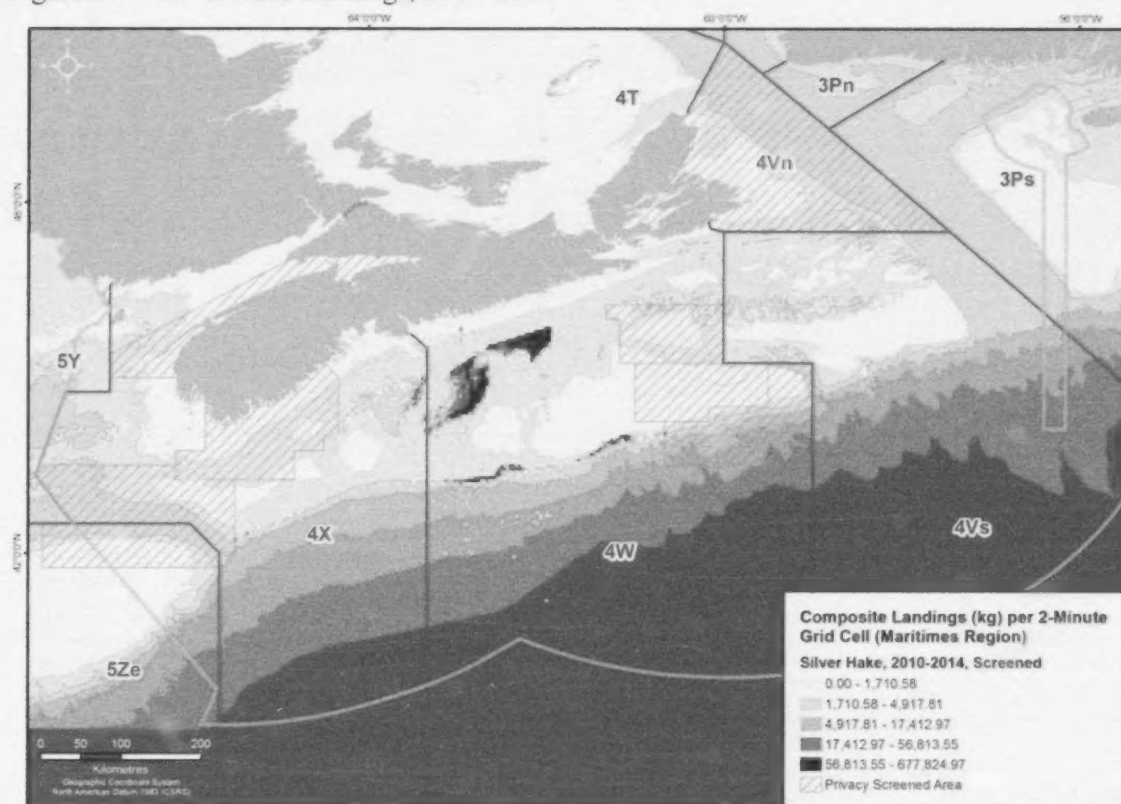
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Silver hake (*Merluccius bilinearis*) is a demersal-pelagic gadid fish found in shallow waters to 400 m depth from Cape Hatteras to the southern Grand Banks and Gulf of St. Lawrence. The distribution of silver hake juveniles and adults is associated with warm bottom temperatures of 5–12° C and 7–10° C, respectively. A population of silver hake occurs on the Scotian Shelf in NAFO Divisions 4VWX and is considered to be a self-reproducing stock. This population aggregates in the deep-water depressions of the Scotian Shelf in Emerald and LaHave Basins, and in the warm slope water, except during the spawning period from July to September when large numbers occur on the shelf in shallow waters around Sable Island Bank. From 1995 to present, a commercial fishery has been conducted by the < 65' mobile gear fleet in Emerald and LaHave Basins (Figure 20). The fishery is restricted to areas with depths greater than 190 m and uses small-mesh trawl gear that also captures other bycatch species.

Figure 20.—Silver Hake Landings, 2010–2014



Monkfish (Figure 21)

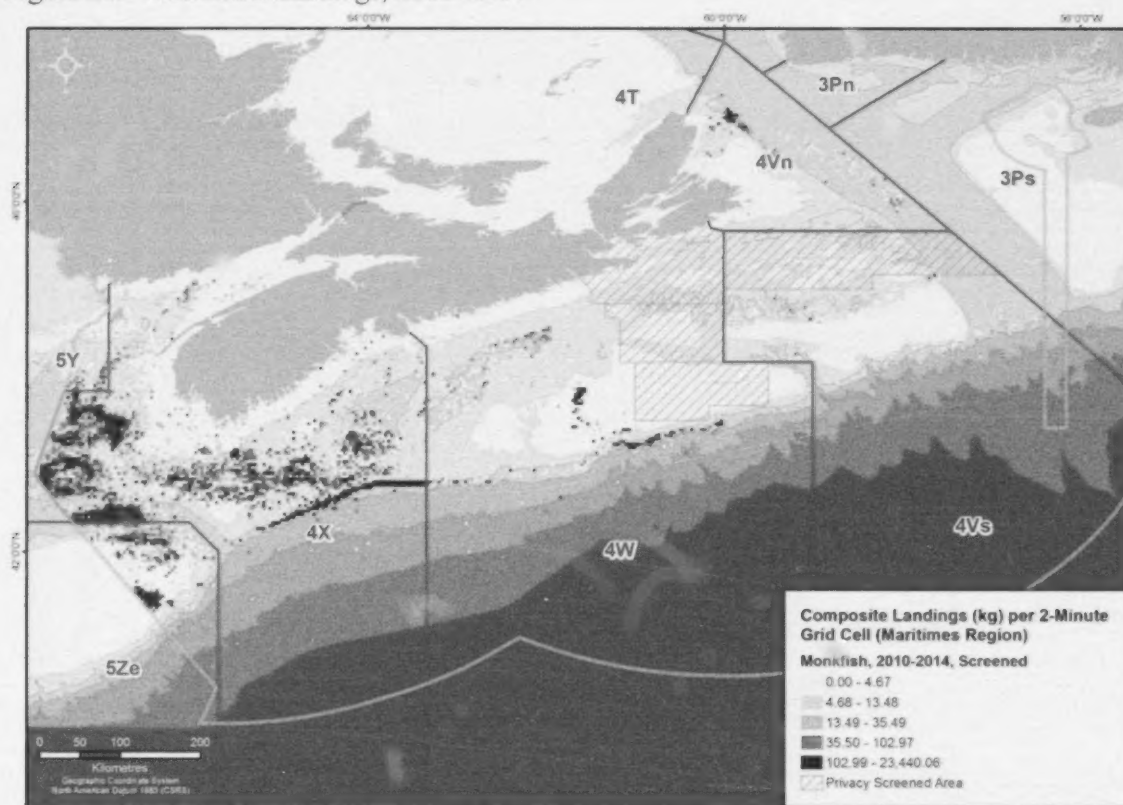
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Monkfish (*Lophius americanus*), also called goosefish or anglerfish, is a benthic fish distributed from the northern Gulf of St. Lawrence to Cape Hatteras. Monkfish are typically a bycatch in groundfish and scallop fisheries on the Scotian Shelf and Georges Bank. Figure 21 shows that monkfish are mainly caught along the edge of the Laurentian Channel, in the Bay of Fundy and its approaches, and on the Scotian Shelf, particularly along the edges of banks.

Figure 21.—Monkfish Landings, 2010–2014



Sculpin (Figure 22)

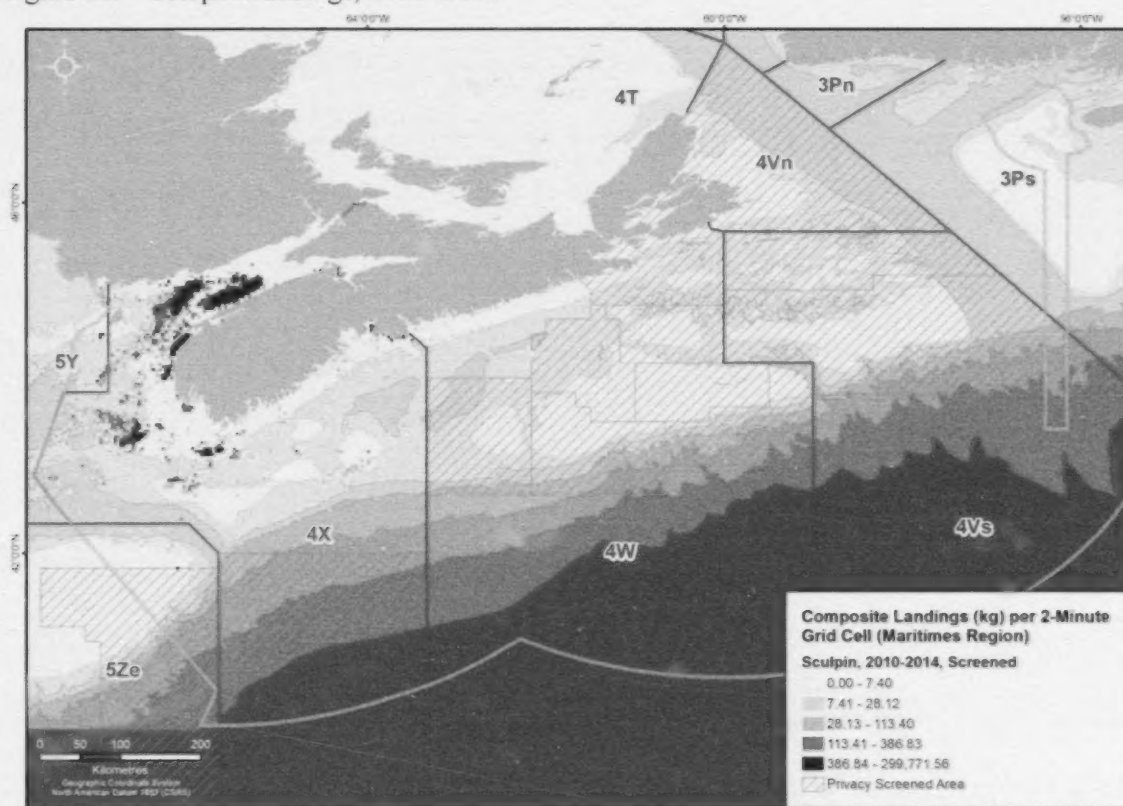
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Sculpins are bottom dwelling, opportunistic feeders distributed throughout coastal shelf seas of the Northwest Atlantic. Common sculpin species in the DFO Maritimes Region include longhorn sculpin (*Myoxocephalus octodecemspinosus*), moustache sculpin (*Triglops murrayi*), and sea raven/sea sculpin (*Hemitripterus americanus*). A directed fishery for longhorn sculpin began in 1999 in St. Mary's Bay in southwest Nova Scotia using otter trawl, longline and handline (DFO, 2008). All other sculpin landings in Figure 22 are groundfish longline and trawl bycatches.

Figure 22.—Sculpin Landings, 2010–2014



Skate (Figure 23)

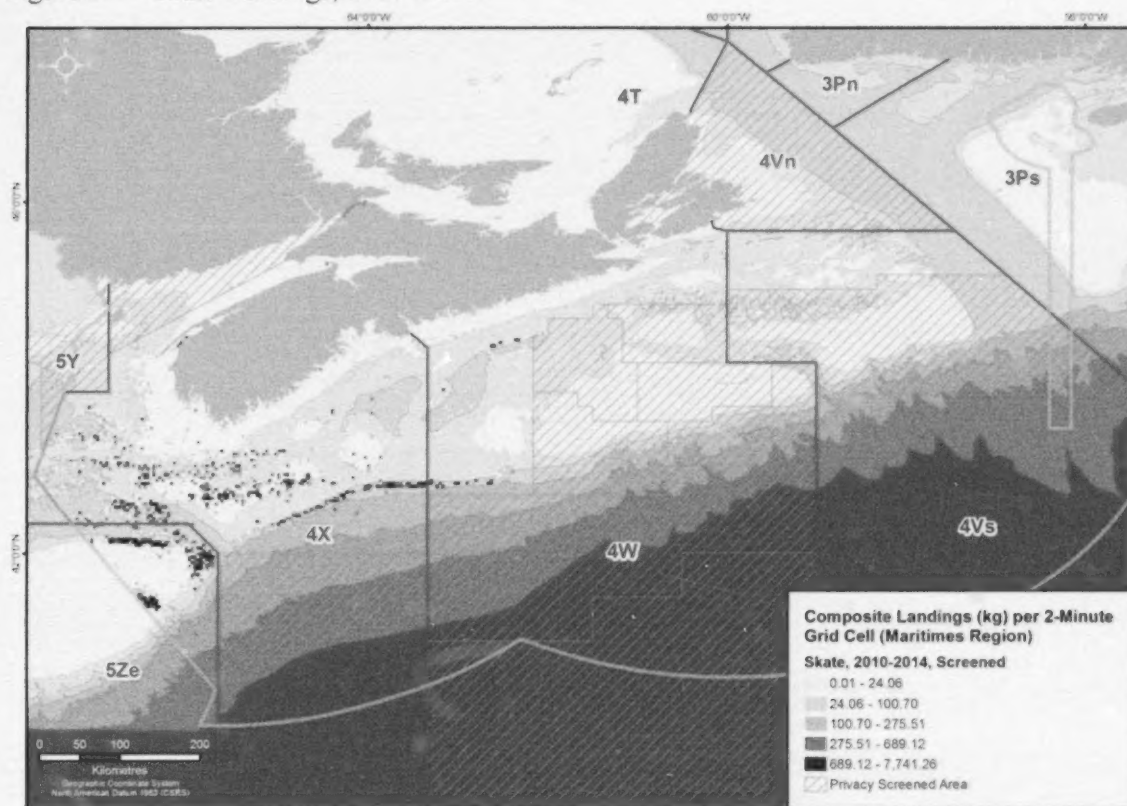
SARA Status: No Status.

COSEWIC Status: Winter Skate (*Leucoraja ocellata*), Georges Bank-Western Scotian Shelf-Bay of Fundy population, Not at Risk; Eastern Scotian Shelf-Newfoundland population, Endangered. Smooth Skate (*Malacoraja senta*), Laurentian-Scotian population, Special Concern. Thorny Skate (*Amblyraja radiata*), Atlantic Ocean, Special Concern.

MSC Status: Not in MSC program.

There is no directed skate fishery in the Maritimes Region, but skates can be retained or discarded, with the exception of thorny skate (*Amblyraja radiata*), which must be returned to the water. There are no quotas or bycatch caps on skates, but a general bycatch provision applies in which no more than 10 percent of the catch at the fleet level should comprise skates. If catches exceed 10 percent, fleet closures or other measures to reduce skate capture are considered. A voluntary move-away protocol exists for thorny skates. Figure 23 depicts the distribution of landed skates primarily on the Western Scotian Shelf in 4X and on Georges Bank in 5Ze.

Figure 23.—Skate Landings, 2010–2014



Squid (Figure 24)

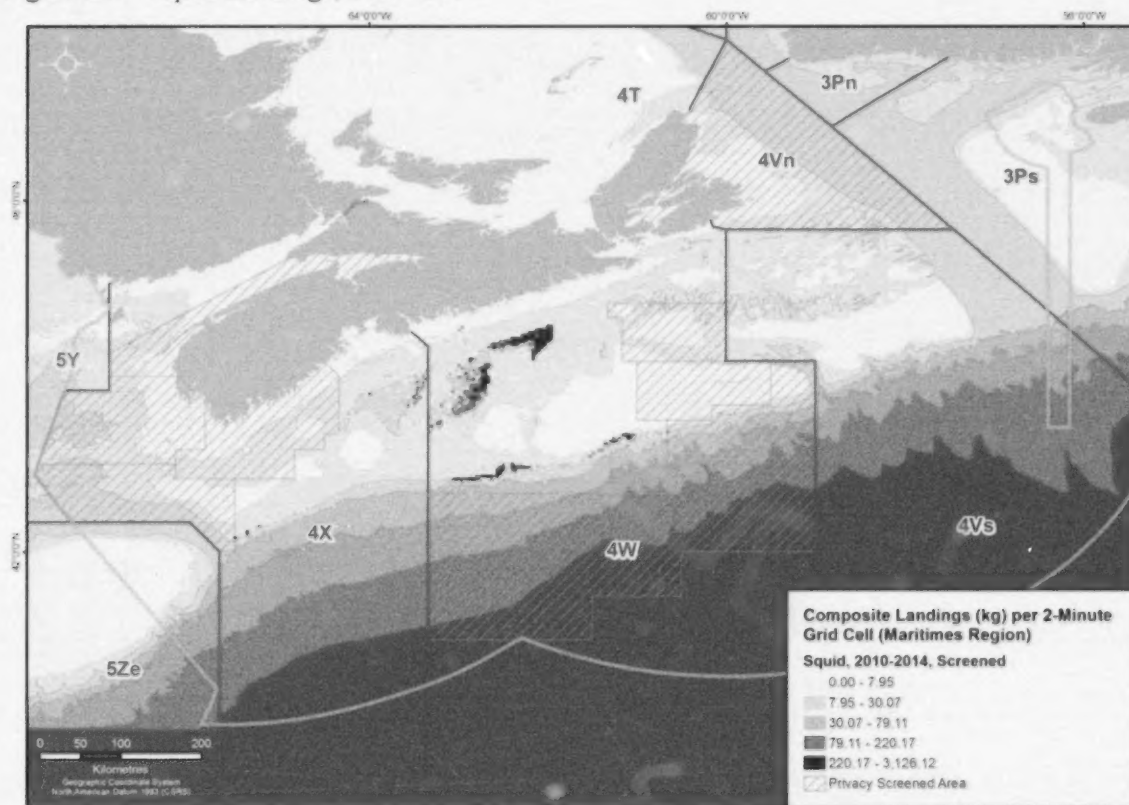
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

The short-finned squid (*Illex illecebrosus*) fishery is conducted from April 1 to December 31 using jiggers and handlines as per squid licence conditions; however, individual licences may also permit the use of otter trawl, purse seine, gillnet, and trap net. Section 74 of the *Atlantic Fishery Regulations* on squid states that no person shall fish for squid with an otter trawl with a mesh size less than 60 mm and that closure times may be set. Squid fishing is permitted in squid fishing areas 17–20, including all of the Eastern and Western Scotian Shelf to the 200-nautical mile limit, but excluding most of the Bay of Fundy. Prohibited areas include the Gully MPA and the Lophelia and Northeast Channel Coral Conservation Areas. Figure 24 shows the distribution of squid landings on the Scotian Shelf that include bycatch in the silver hake trawl fishery in Emerald and LaHave Basins.

Figure 24.—Squid Landings, 2010–2014



White Hake (Figure 25)

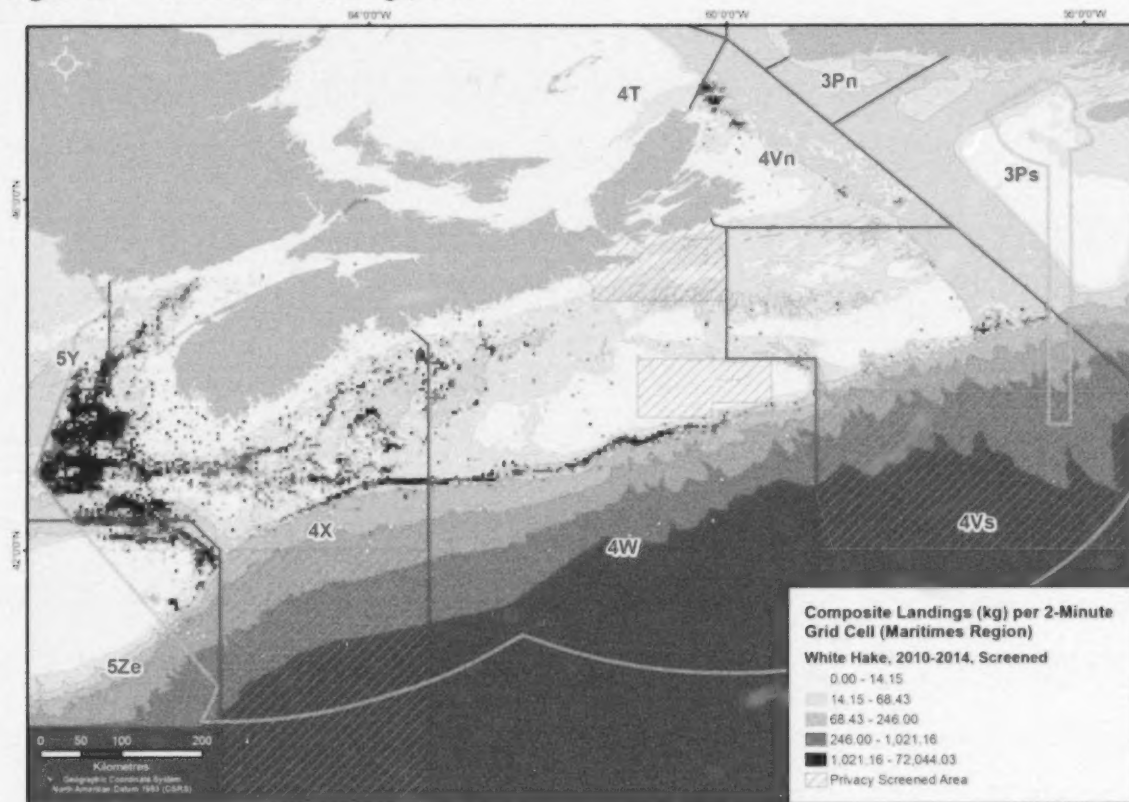
SARA Status: No Status.

COSEWIC Status: Threatened.

MSC Status: Not in MSC program.

White hake (*Urophycis tenuis*) is a bycatch species only in DFO Maritimes Region, with fleets operating within bycatch caps. White hake landings are broadly distributed across the Scotian Shelf and into the Bay of Fundy, with a number of concentrated areas: the Gulf of Maine, Georges Bank, the edge of the Scotian Shelf, and parts of Laurentian Channel (Figure 25).

Figure 25.—White Hake Landings, 2010–2014

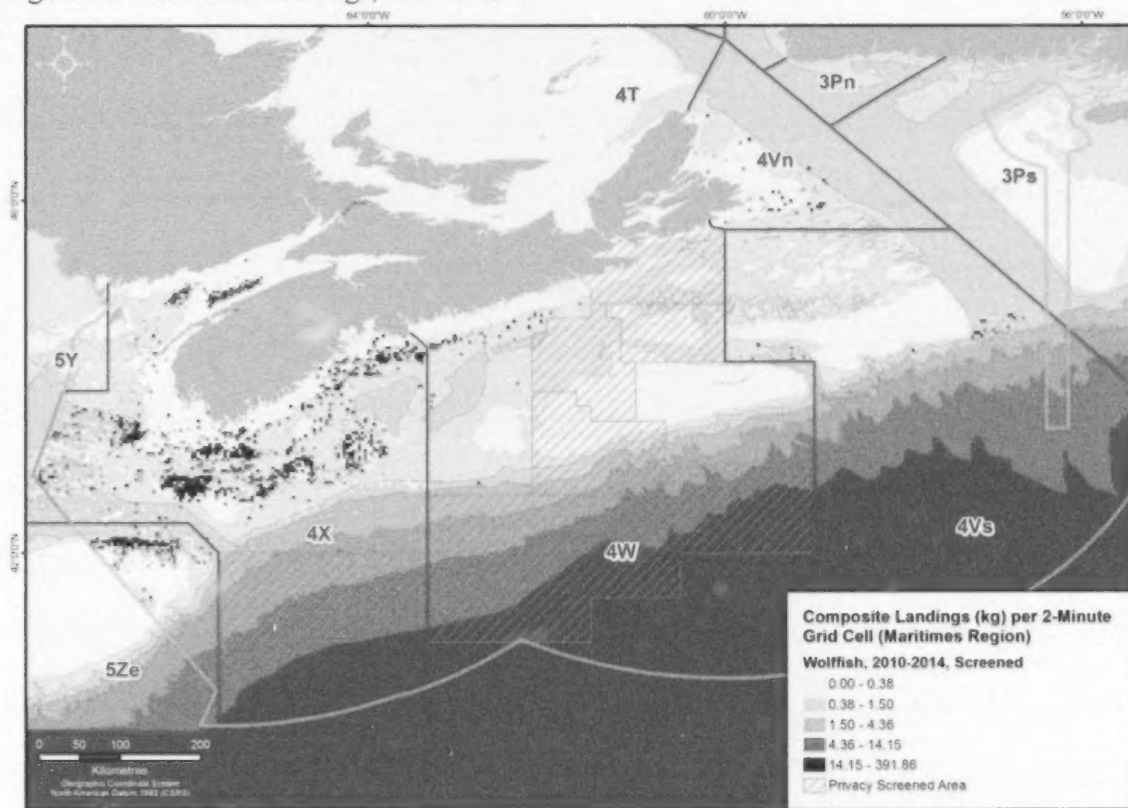


Wolffish (Figure 26)

SARA Status: Atlantic Wolffish (*Anarhichas lupus*), Special Concern. Northern Wolffish (*Anarhichas denticulatus*), Threatened. Spotted Wolffish (*Anarhichas minor*), Threatened.
COSEWIC Status: Atlantic Wolffish (*Anarhichas lupus*), Special Concern. Northern Wolffish (*Anarhichas denticulatus*), Threatened. Spotted Wolffish (*Anarhichas minor*), Threatened.
MSC Status: Not in MSC program.

The Atlantic wolffish is a large bottom-dwelling predatory marine fish widely distributed across the North Atlantic (Kulka et al., 2008). It occurs off the west coast of Greenland and southern Labrador, in the Strait of Belle Isle, and the Gulf of St. Lawrence. It is also found off the east and west coasts of Newfoundland, on the Grand Banks, and from the Scotian Shelf to the Gulf of Maine. The Atlantic wolffish is found in commercial catches, at one time as a target species but now only as bycatch. The northern wolffish is found across the North Atlantic from Norway to southern Newfoundland, primarily off northeast Newfoundland. The spotted wolffish is found across the North Atlantic from Scotland to Cape Breton and in the Arctic Ocean. In the Northwest Atlantic it occurs primarily off northeast Newfoundland. Although the Northern wolffish and spotted wolffish are not targeted by the fishing industry, they are taken as bycatch by offshore trawlers. Figure 26 shows catch weight landings for all three wolffish species.

Figure 26.—Wolffish Landings, 2010–2014



Herring (Figure 27)

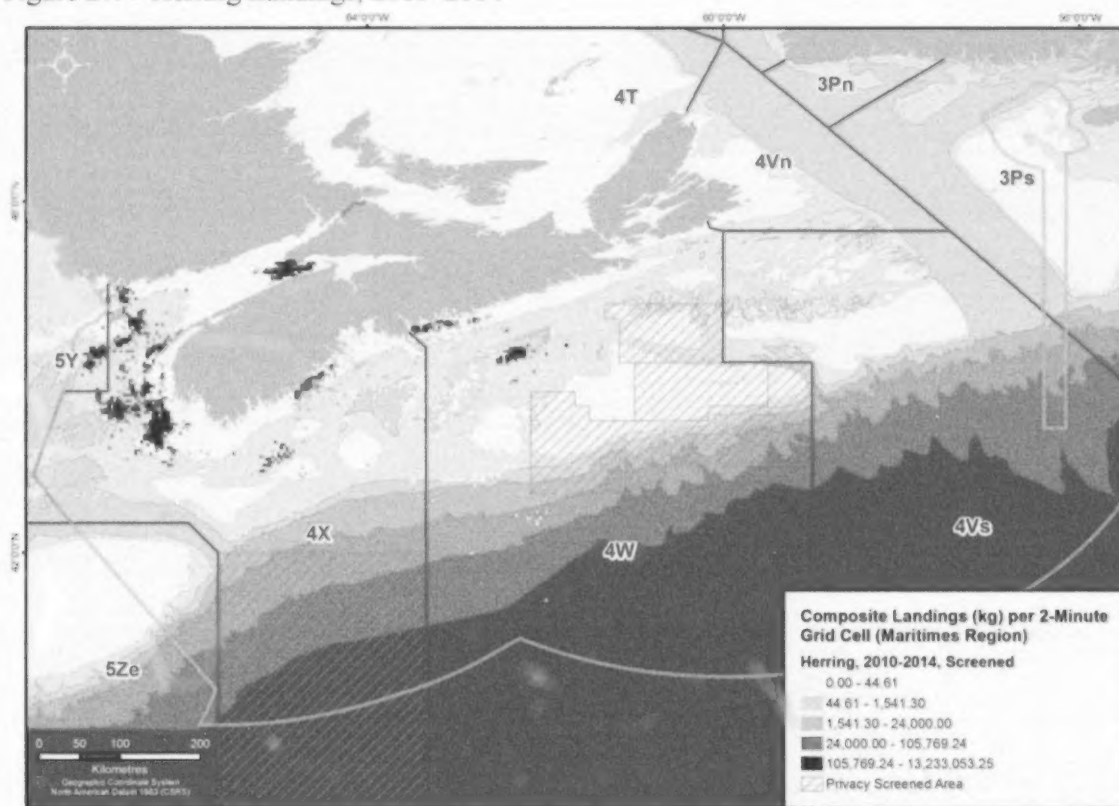
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Purse seine herring certified in November 2016.

The 4VWX herring (*Clupea harengus*) fishery is comprised of four spawning components: 1) Southwest Nova Scotia/Bay of Fundy; 2) Offshore Scotian Shelf Banks; 3) Coastal Nova Scotia; and 4) Southwest New Brunswick migrant juveniles. Each component has several spawning areas and a mixing of fish among the spawning components. The 4VWX herring fishery is open year-round, with the majority of the landings occurring in the summer purse seine fishery from May to October in the Bay of Fundy area. Figure 27 shows herring landings off Scots Bay (Upper Bay of Fundy), German Bank, Trinity Ledge, Port Mouton, Eastern Shore, and herring bycatch in the silver hake fishing areas in Emerald and LaHave Basins.

Figure 27.—Herring Landings, 2010–2014



Mackerel (Figure 28)

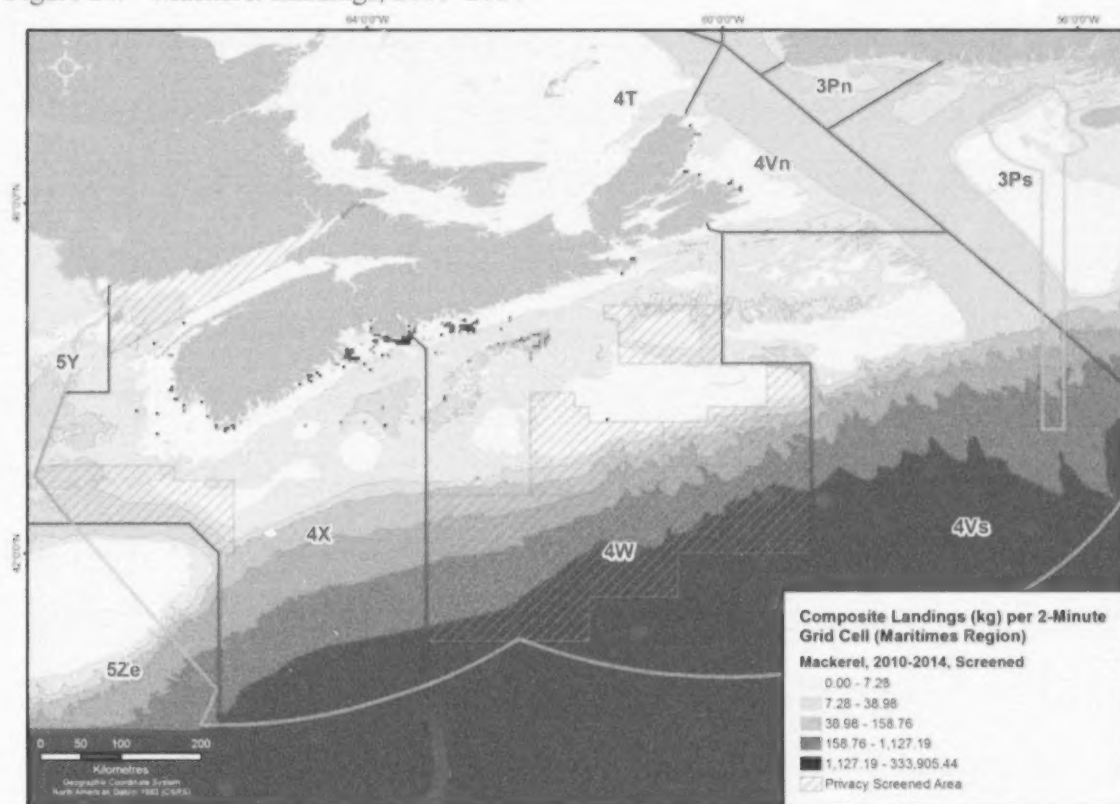
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Inshore gillnet and trap fisheries for Atlantic mackerel (*Scomber scombrus*) take place primarily in June and July in Nova Scotia, with the main trap net fishery for mackerel being in St. Margaret's Bay (Figure 28). In late summer and fall, a mackerel handline fishery operates and a herring purse seine fishery also lands mackerel. Mackerel is also a bycatch of the silver hake fishery in Emerald and LaHave Basins. The patterns in Figure 28 may not represent the extent of the coastal mackerel bait fishery.

Figure 28.—Mackerel Landings, 2010–2014



Bluefin Tuna (Figure 29)

SARA Status: No status.

COSEWIC Status: Endangered.

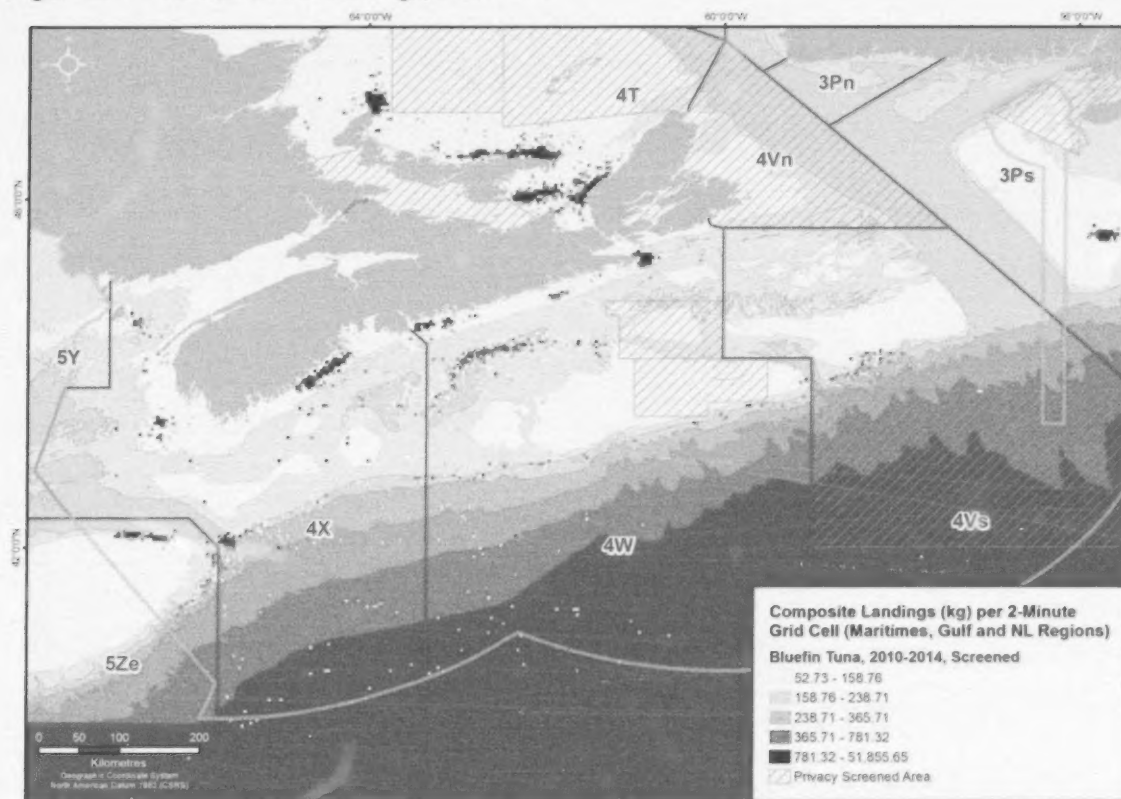
MSC Status: Not in MSC program.

The Atlantic bluefin tuna (*Thunnus thynnus*) fishery is conducted inter-regionally (see Figure 29) in the following areas: the Hell Hole between Browns and Georges Banks off southwest Nova Scotia; off Grand Manan, NB; St. Margaret's Bay, NS; south of the Canso Causeway, NS; off Cape George in the eastern part of the Northumberland Strait; off North Cape and East Point, PEI; in St. Georges Bay north of the Canso Causeway; and off the southern coast of Newfoundland. Since 1996, bluefin tuna have been taken off the coast of Nova Scotia between the Hell Hole and Canso fisheries, particularly off Halifax. Bluefin are also taken along the Scotian Shelf edge as a bycatch of the pelagic longline fleet directing for swordfish and tuna species other than bluefin tuna. NAFO area 4Vn (east of Cape Breton) is closed to bluefin tuna harvests.

Bluefin tuna gears include: angling gear (rod and reel with single line and hook); tended trolling line (line with one hook attached at all times to a fishing vessel); trap (trap nets are only used in St. Margaret's Bay, Nova Scotia); electric harpoon (electrically powered barbed spear attached to a long rope); and pelagic longline (3.5 mm line suspended by floats, with a series of baited hooks attached at regular intervals fishing the upper water column). Pelagic longlines are 30 to 50 miles long, have 600–1,100 baited hooks per set, and are used by offshore tuna licence and swordfish and other tuna licence holders. There is no directed tuna fishery using longline, as it is only caught as bycatch; however, bycatch landings exceed tended line landings.

The bluefin tuna fishing season runs from January 1 to December 31, with the main directed fishery running from late July until mid-to-late November. A charter fishery is also permitted during the commercial catch and retain season for existing bluefin tuna licence holders. The charter fishery takes place during September and October off Nova Scotia, July to October in the Gulf of St. Lawrence, and July 15 to December 31 in Newfoundland and Labrador (DFO Bluefin Tuna Integrated Fisheries Management Plan, 2015).

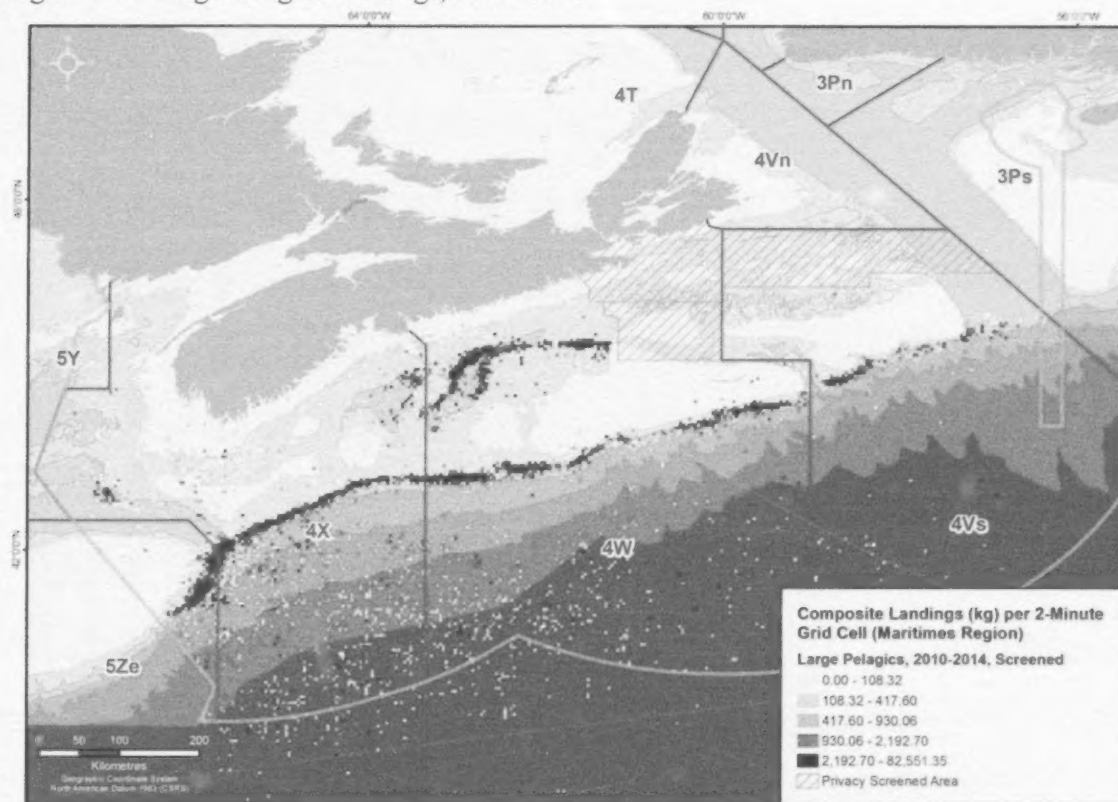
Figure 29.—Bluefin Tuna Landings, 2010–2014



Large Pelagics (Figure 30)

The large pelagics species grouping shown in Figure 30 includes swordfish (*Xiphias gladius*), albacore tuna (*Thunnus alalunga*), bigeye tuna, (*Thunnus obesus*), and yellowfin tuna (*Thunnus albacares*). Pelagic longlines and harpoon gear are permitted to operate from Georges Bank to Flemish Cap east of Newfoundland when swordfish migrate into and adjacent to the Canadian exclusive economic zone (EEZ). The longline fishery is a multi-species fishery as swordfish longline licence conditions are used in conjunction with licence conditions for the other tunas (e.g., Albacore, Bigeye, and Yellowfin) and together identify authorized directed species, as well as permitted bycatch species (e.g., shark and marlin). Longline fishing effort generally progresses from west to east and back again, and from the offshore to the inshore along the edge of the continental shelf following swordfish movements associated with seasonal surface water warming trends, and a northward flow of the Gulf Stream. The Canadian large pelagic longline fisheries that direct for, or incidentally catch, swordfish operate from April to December. Swordfish harpooning occurs from June to late August primarily along the edge of Georges and Browns Banks, targeting large females basking in surface waters during daylight.

Figure 30.—Large Pelagics Landings, 2010–2014



Swordfish (Figure 31)

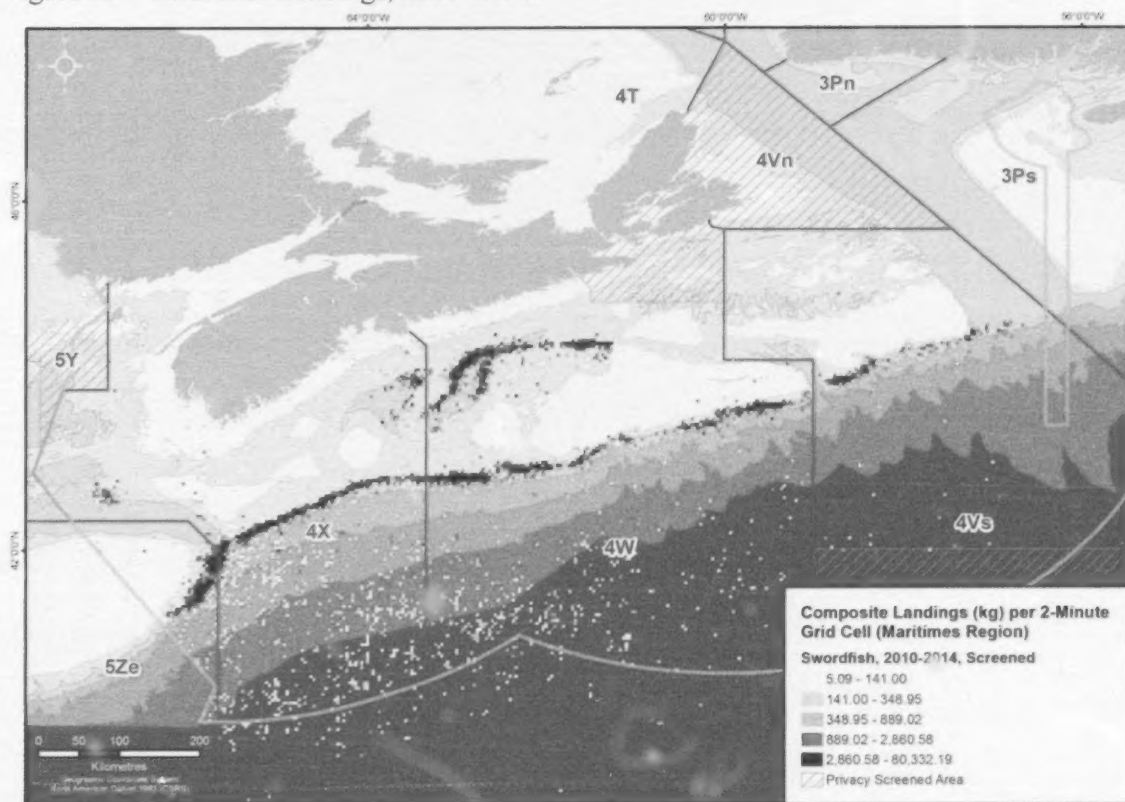
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Longline swordfish certified sustainable in April 2012. Harpoon swordfish certified sustainable on 18 June 2010.

North Atlantic swordfish and tuna stocks are under the management of the International Commission for the Conservation of Atlantic Tunas (ICCAT). Pelagic longlines and electric harpoons are permitted in this fishery off Nova Scotia and Newfoundland. Swordfish longline licence conditions are used in conjunction with licence conditions for the other tunas (e.g., Albacore, Bigeye, and Yellowfin) and together identify the authorized directed species as well as permitted by-catch species (e.g., shark and marlin). The longline fishery extends from Georges Bank to the Flemish Cap east of Newfoundland when swordfish, the main species targeted, migrate into and adjacent to the Canadian EEZ (Figure 31). Longline fishing effort generally progresses from west to east and back again and from offshore to inshore along the edge of the continental shelf following swordfish migrations associated with seasonal warming trends of surface water temperature, and the northward flow of the edge of the Gulf Stream. Canadian large pelagic longline fisheries that direct for, or incidentally catch, swordfish operate from April to December. Swordfish longline licences are also able to use harpoon gear. The harpoon fishery occurs from June to late August, along the edges of Georges and Browns Banks, targeting large female swordfish basking in surface waters during daylight (DFO, 2013b).

Figure 31.—Swordfish Landings, 2010–2014



Other Tuna (Figure 32)

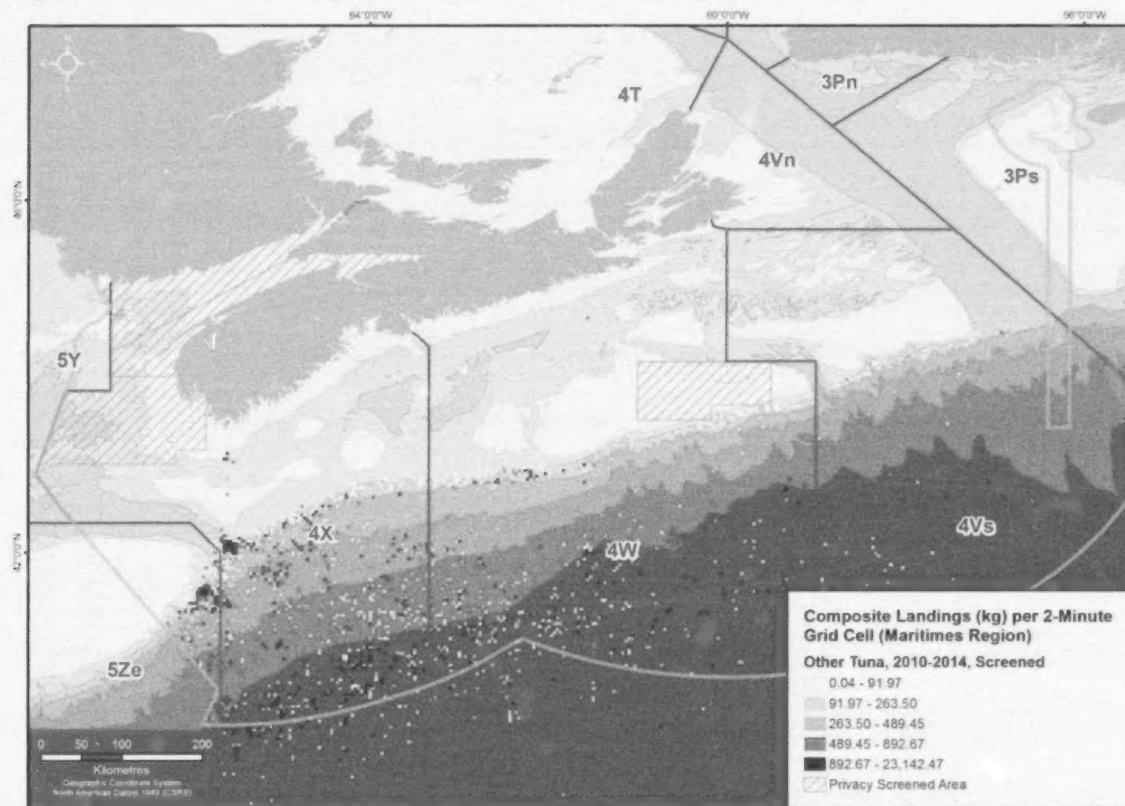
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

The albacore, bigeye, and yellowfin tuna fishery is known as the “Other Tuna” fishery to distinguish it from the bluefin tuna fishery. The fishery occurs from September to late November. Tunas are highly migratory and catch limits are set by the International Commission for the Conservation of Atlantic Tunas (ICCAT). The directed other tuna fishery began in the mid-1990s, as these species were previously bycatch in the swordfish longline fishery. In addition to longline, trolling gear is used where multiple lines with lures and hooks are towed behind a fishing vessel. The fishery occurs along the shelf edge and slope. The slope of the western Scotian Shelf is more important for this fishery than the eastern Scotian Shelf slope (Figure 32). The same management areas are in place as for the swordfish longline fishery. Fishing Zone 1 (Gulf of St. Lawrence) and Fishing Zone 2 (Bay of Fundy) are closed to the fishery. Fishing is not permitted in the Hell Hole (Northeast Channel) from July to November to reduce bluefin tuna bycatch. The Bluefin Exclusion Zone, an area along coastal Nova Scotia, is closed from August 1 till the end of the season to prevent bluefin tuna bycatch.

Figure 32.—Albacore, Bigeye, and Yellowfin Tuna Landings, 2010–2014



Porbeagle, Shortfin Mako and Blue Sharks (Figure 33)

SARA Status: Porbeagle, No Status; Shortfin Mako, No Status; Blue shark, No Status.

COSEWIC Status: Porbeagle, Endangered; Shortfin Mako, Threatened; Blue shark, Not at risk.

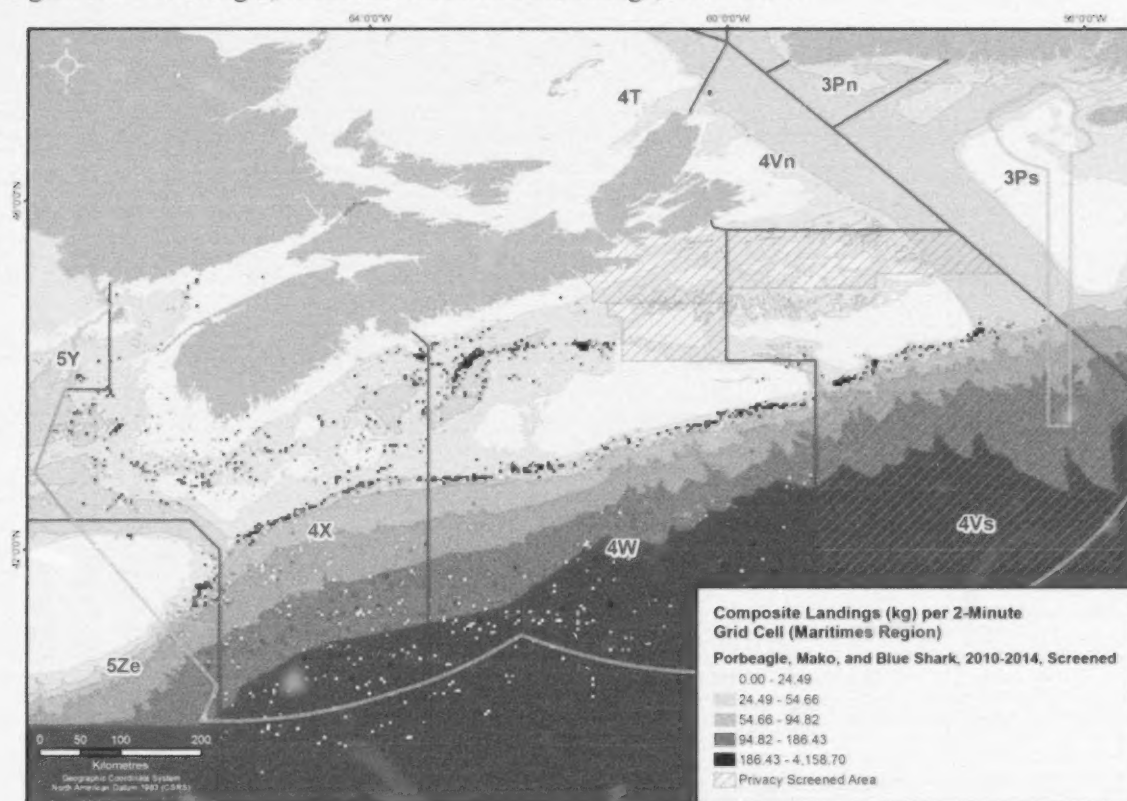
MSC Status: Not in MSC program.

The porbeagle shark (*Lamna nasus*) is a cold-temperate species that ranges in the northwestern Atlantic from Newfoundland and Labrador to the Sargasso Sea, inhabiting inshore and offshore waters below 18 °C. Individuals from this population move onto the Scotian Shelf in early spring and into the Gulf of St. Lawrence and onto the Grand Banks during the late spring and summer (Figure 33). They move into deeper water in late fall and in winter are found off the continental shelf and in deep basins such as Emerald Basin and the Gulf of Maine. Although there is no longer a directed porbeagle shark fishery, a 185-tonne total allowable catch is applied to all incidental bycatch landings.

The shortfin mako shark (*Isurus oxyrinchus*) is a warm-temperate, tropical species that occurs in the Atlantic, Pacific and Indian oceans. The species' range in the western Atlantic extends from Newfoundland to Argentina in water temperatures from 17 to 22 °C. Shortfin mako sharks occur primarily off the continental shelf, but may be found in Canadian Atlantic coastal waters during the summer months. In Canadian waters, shortfin mako is a valuable bycatch with a higher price per pound than blue shark. It is caught incidentally in the same fisheries as porbeagle and blue sharks, though because of a preference for warmer water temperatures, not in the same proportions. Fisheries with a bycatch of shortfin mako include swordfish longline, other tunas longline, groundfish gillnet, and groundfish longline, with bycatch in groundfish occurring mostly in waters south of the shelf waters off Nova Scotia near the Gulf Stream. DFO applies a precautionary shortfin mako allocation of 100 tonnes annually based on a recovery potential assessment. The swordfish longline fleet has been releasing all live shortfin mako sharks to reduce mortality. In addition, all landings are 100 percent dockside monitored at the time of offloading.

Blue sharks (*Prionace glauca*) are probably the most widely distributed of all large pelagic shark species and are found globally. The species' range extends from Newfoundland to Argentina in the western Atlantic. They prefer water temperatures in the range of 13–21 °C, but can tolerate from 7–27 °C. They move onto the Scotian Shelf in the late spring and into the Gulf of St. Lawrence and onto the Grand Banks during the summer and early fall. In late fall they move into deeper water, and in winter they are found off the continental shelf. Other than dogfish, Blue sharks are the most common shark bycatch in Canadian waters with the most significant catches in the large pelagic longline fishery (e.g., the Swordfish fleet where the number of Blue sharks caught can exceed swordfish caught). Blue sharks are currently almost always discarded, but when retained there is a precautionary allocation of 250 tonnes.

Figure 33.—Porbeagle, Mako and Blue Shark Landings, 2010–2014



Snow Crab (Figure 34)

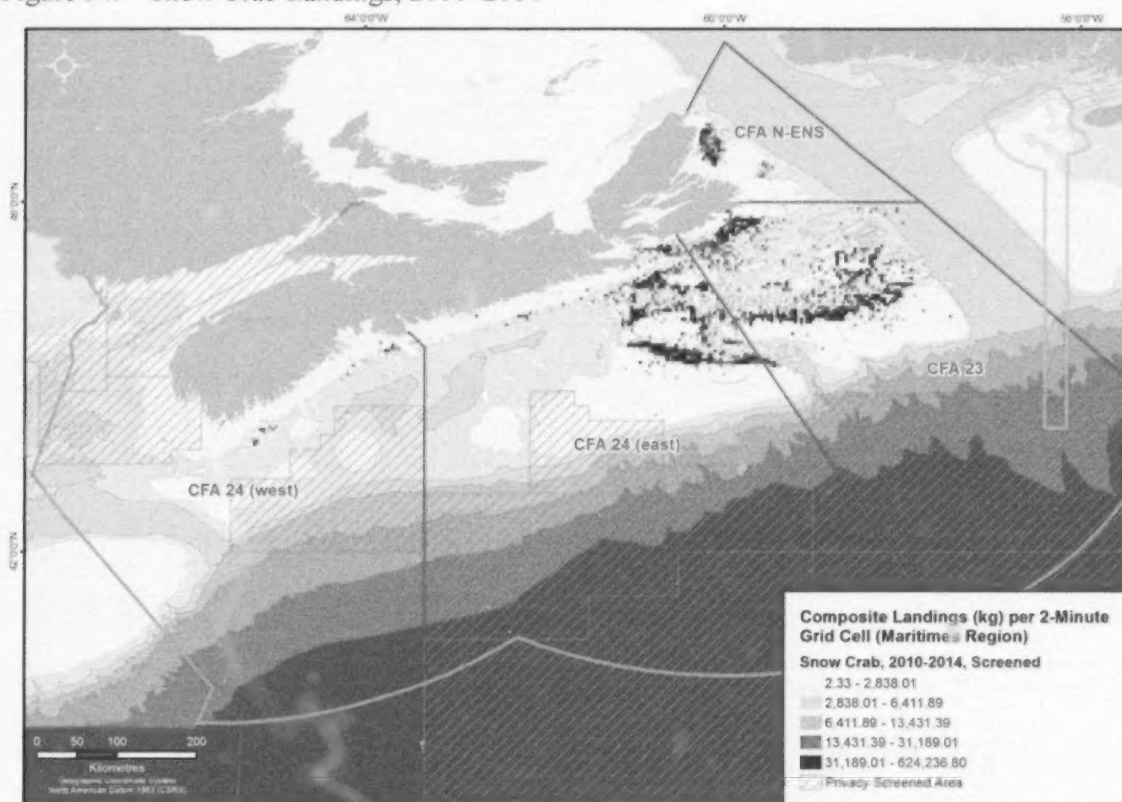
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Scotian Shelf snow crab trap fishery certified sustainable in July 2012.

The snow crab (*Chionoecetes opilio*) fishery operates in NAFO Divisions 4VW in eastern Nova Scotia in Crab Fishing Areas (CFAs) 20–22, now combined as Northeastern NS (N-ENS), CFA 23, CFA 24 East and CFA 24 West (Figure 34). Snow crab fishable bottom can be patchy within areas. In the nearshore areas of N-ENS the habitat is continuous from within five miles of shore out to 15–20 miles. In southern areas of CFA N-ENS and CFAs 23–24 the fishable bottom is not evenly distributed and extends further offshore. Snow crab is found here in gullies 15–20 miles from shore extending to 120 miles offshore. The snow crab fishery uses baited conical traps. In N-ENS the spring fishery operates from early April till mid-to-late May, while the summer fishery runs from mid-July till mid-August. In CFAs 23–24 the season runs from early April till the end of September. The CFA 24 West seasons opens November 1 and closes March 31 (DFO, 2013a).

Figure 34.—Snow Crab Landings, 2010–2014



Other Crab (Figure 35)

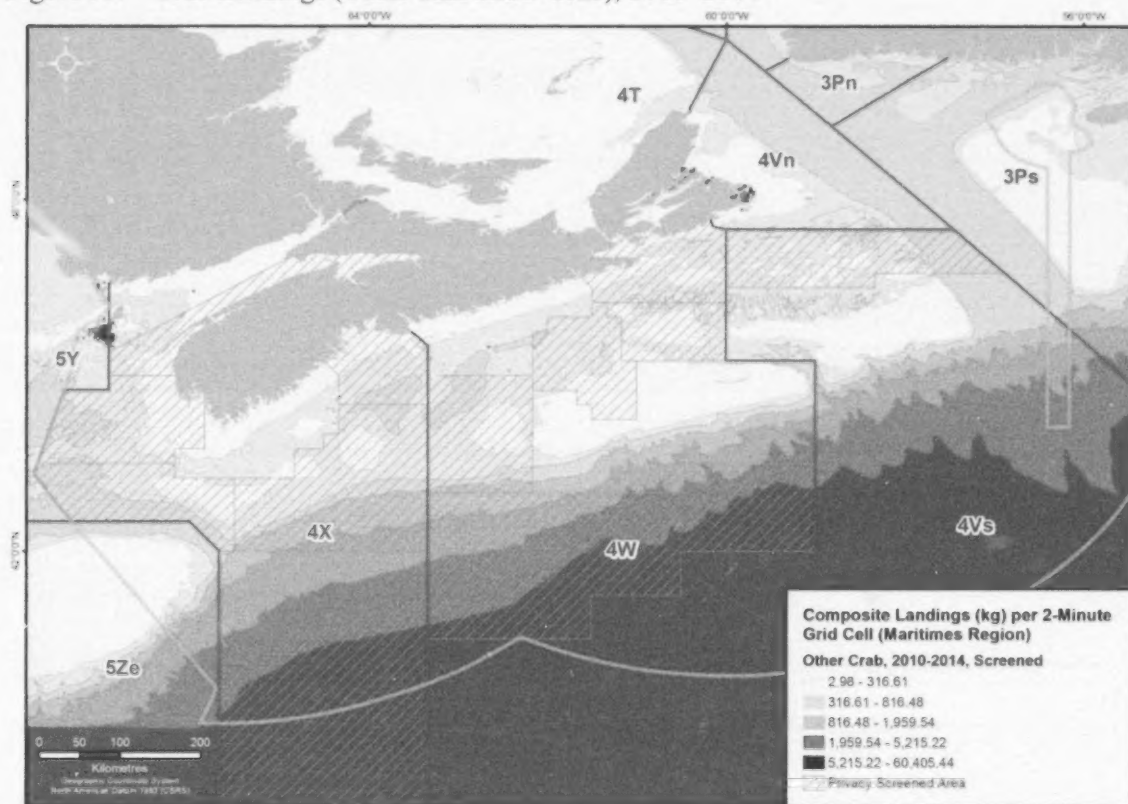
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Fisheries for red crab, Jonah crab, and rock crab are smaller in scale than the snow crab fishery. There are few licence holders in each fishery and a variety of management units are used, which are different in each crab fishery, including crab fishing areas, lobster fishing areas, and NAFO divisions. Offshore Jonah crabs are landed with offshore lobster in LFA 41 with a TAC of 720 tonnes. Most landings in the Jonah crab fishery are from the Bay of Fundy, Crowell Basin and Browns Bank, with landings also from Georges Basin and Bank (Figure 35). A red crab fishery exists in deep waters along the shelf edge. Exploratory fisheries for stone crab and toad crab have existed on the eastern Scotian Shelf since the mid-1990s, with few licence holders and low catches. Figure 35 includes bycatch landings of other crab species.

Figure 35.—Crab Landings (Other than Snow Crab), 2010–2014



Scallop (Figure 36)

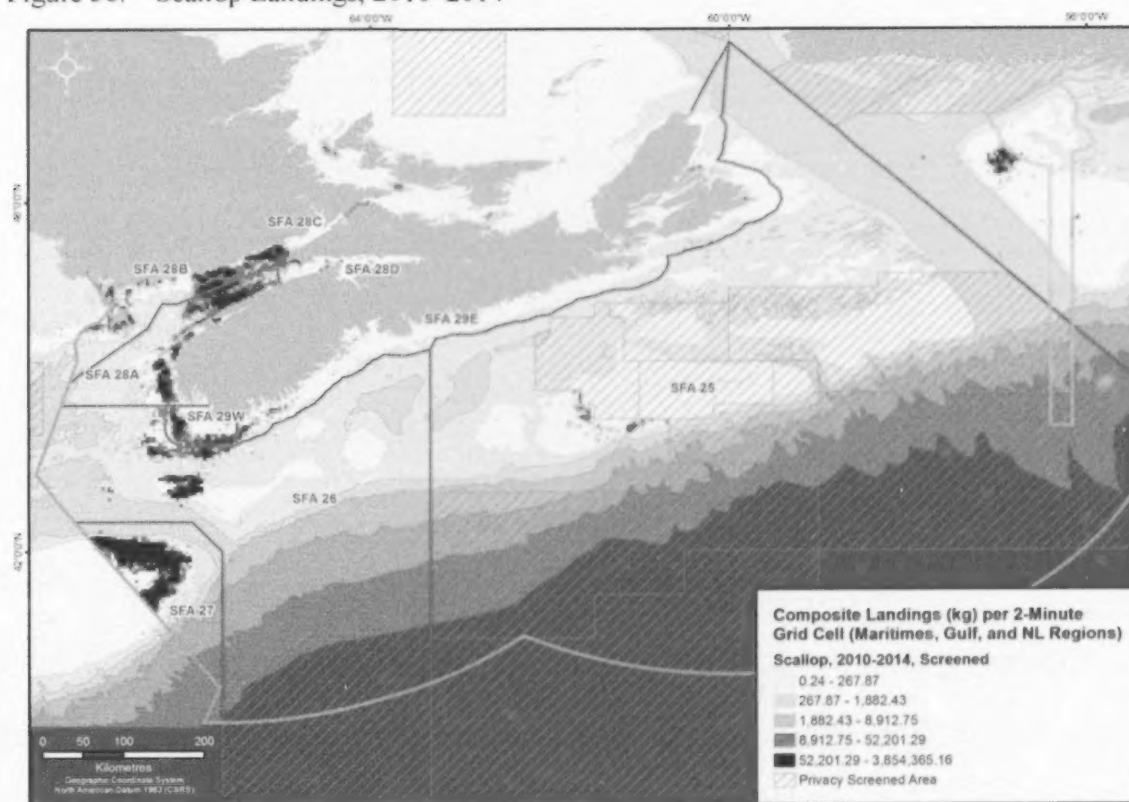
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: The Bay of Fundy and Scallop Fishing Area 29 West of 65° 30' W longitude certified as sustainable in July 2013. The Offshore Scallop fishery was certified in March 2010.

All scallop fishing in the Bay of Fundy takes place in Scallop Fishing Areas (SFA) 28A, 28B, 28C, and 28D as described in the *Atlantic Fishery Regulations, 1985*. The various fleet sectors are eligible by licence condition to fish one or more areas as follows: Full Bay: SFA 28A, 28B, 28C and 28D; Mid Bay: SFA 28B and 28C only; and Upper Bay: SFA 28C and 28D only. These areas can be further sub-divided into areas that are closed by either regulation or variation orders that restrict fishing during all or part of the year. In addition, specific management measures are applied to broader Scallop Production Areas (SPA) that are designed to incorporate one or more scallop biological production areas and may fall within the boundaries of one or more of the regulated SFAs. SPA boundaries are described in variation orders and/or licence conditions whereas SFA boundaries are described in the *Atlantic Fishery Regulations, 1985*. Inshore scallop fishing also takes place in SFA 29 as described in the *Atlantic Fishery Regulations, 1985*. SFA 29 is divided into SFA 29 West of 65°30' W longitude west to the 43°40' Line and SFA 29 East of 65°30' W longitude, east to Cape North and within the 12-nautical mile territorial sea. Two of the fleet sectors are eligible by licence condition to fish one or more areas as follows: Full Bay: SFA 29 West; Inshore: SFA 29 East, 64 licences eligible for SFA 29 West. The offshore scallop fishery in Maritimes Region operates primarily on Georges and Browns Banks, Western and Emerald Banks, and Banquereau (Figure 36). The offshore scallop fishery occurs year-round in the Maritimes Region; however, not all areas are open year-round. German Bank is open from June 1 to November 15. The closure during the late fall and spring is to avoid conflicts with the lobster fishery that takes place in the area from late November till May 31. Georges Bank is open from March 1 to December 31. Area closures may begin if catch rates or yields (measured in number of meats/500 grams) are low (DFO, 2000).

Figure 36.—Scallop Landings, 2010–2014



Scallop Q1–Q4 (Figures 37 to 40)

Quarterly scallop maps are shown in Figures 37–40. Much of Georges Bank shows high landings year-round, reflecting the area's importance to the offshore fishery. There is little activity on the eastern Scotian Shelf during the winter. There are high landings in the area off Digby in the Bay of Fundy for much of the year, reflecting the importance of this area to the inshore fishery. A winter scallop fishery exists around Grand Manan and in the Passamaquoddy Bay area off southwest New Brunswick.

Figure 37.—Seasonal Scallop Landings, January–March, 2010–2014

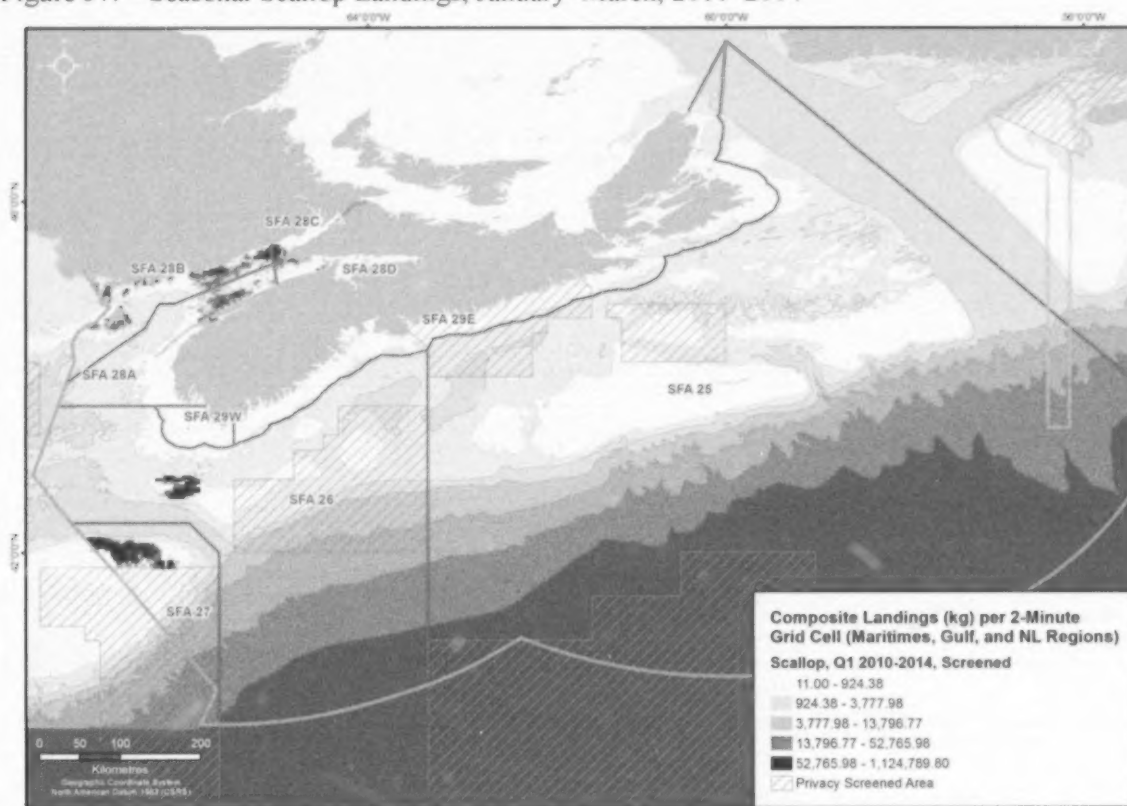


Figure 38.—Seasonal Scallop Landings, April–June, 2010–2014

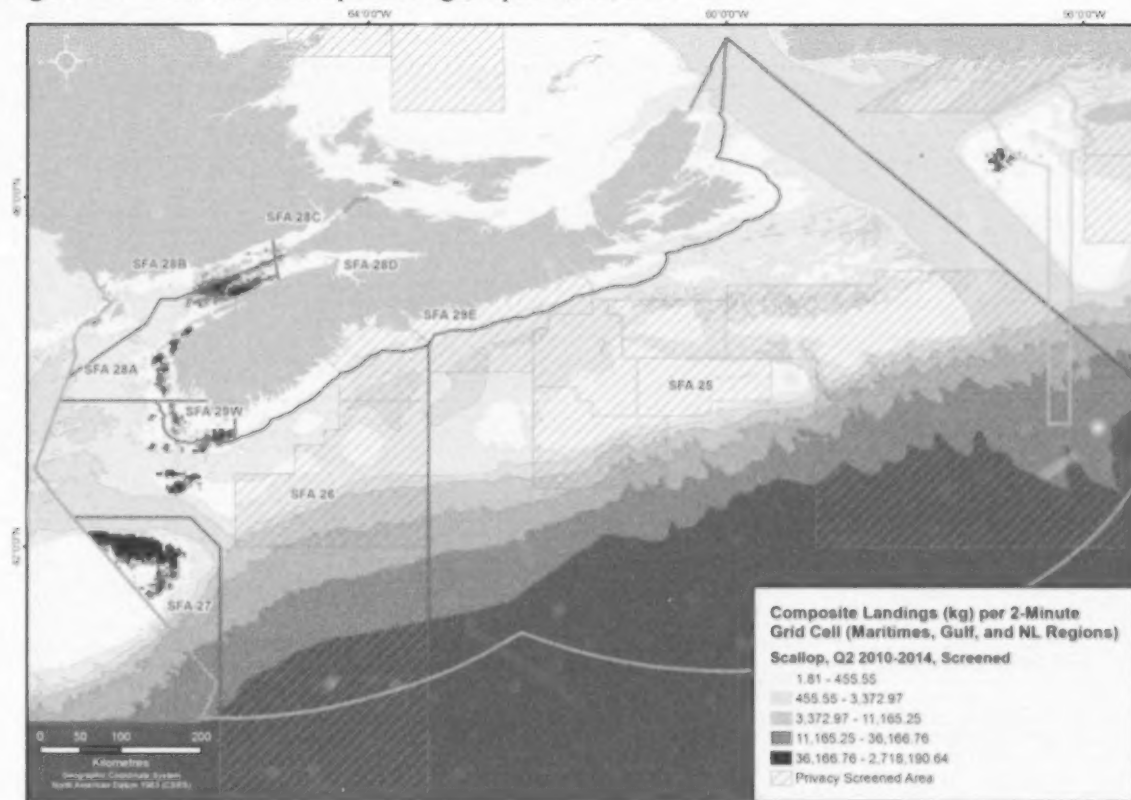


Figure 39.—Seasonal Scallop Landings, July–September, 2010–2014

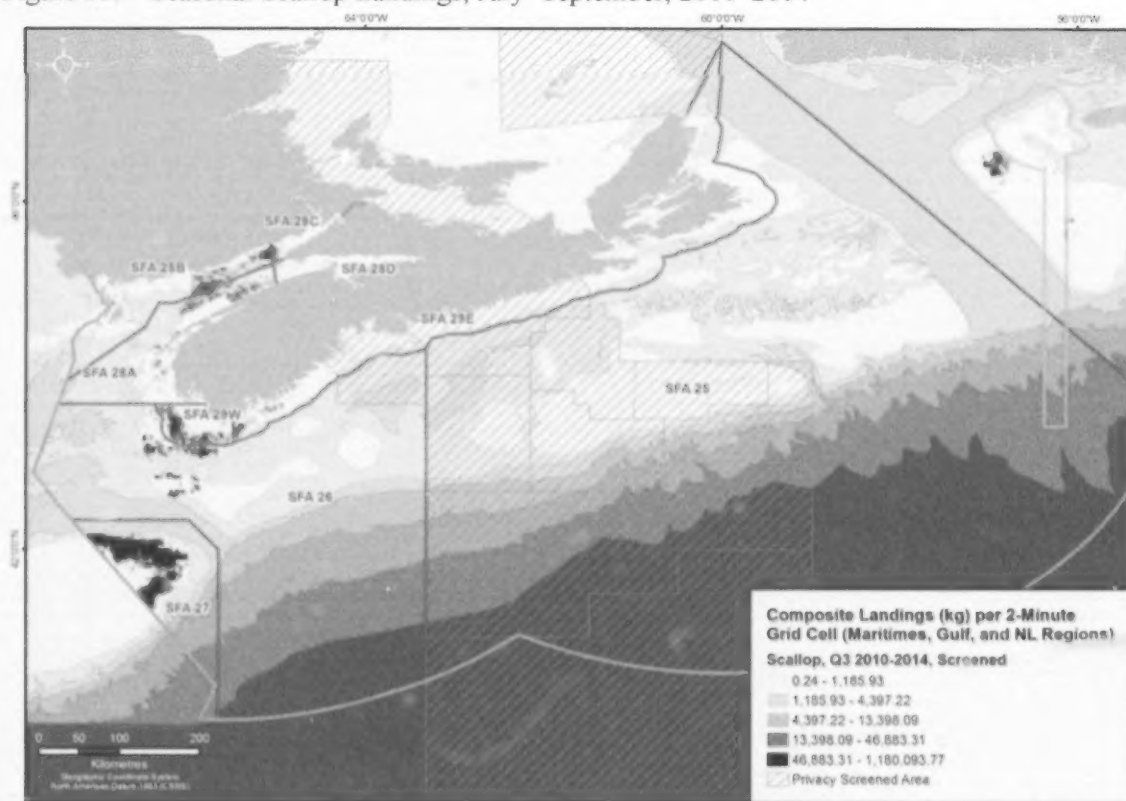
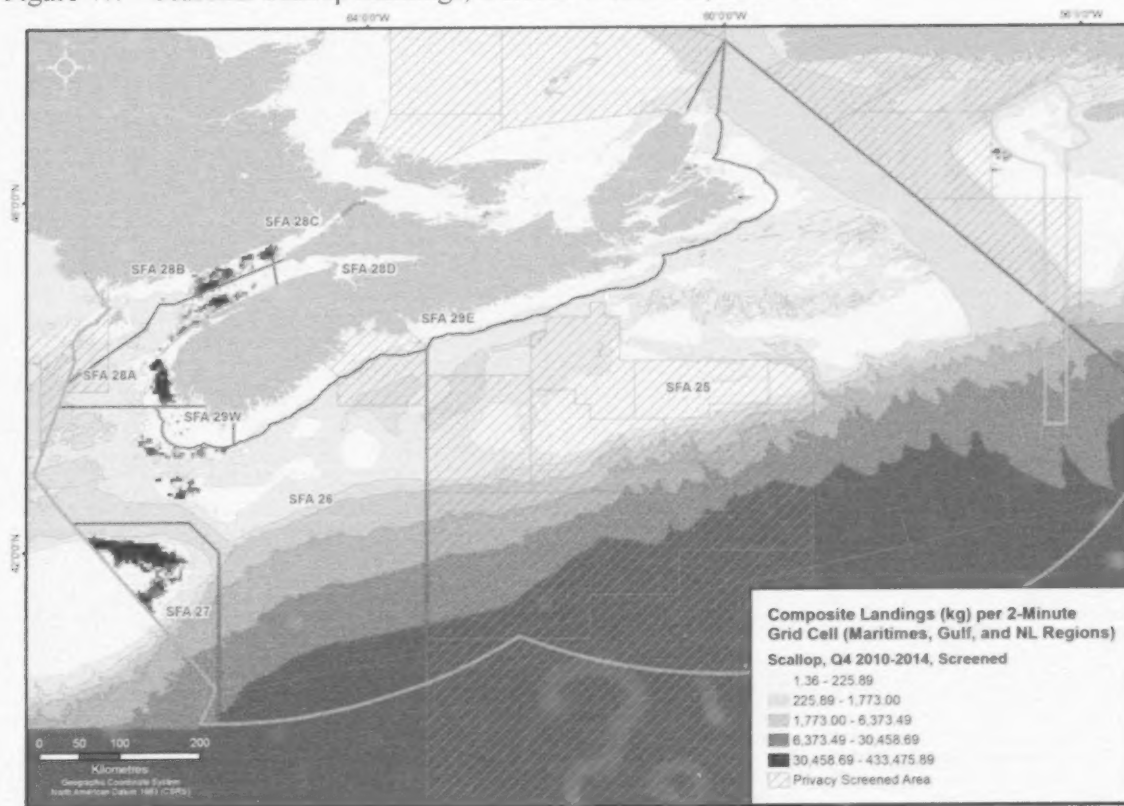


Figure 40.—Seasonal Scallop Landings, October–December, 2010–2014



Offshore Clam (Figure 41)

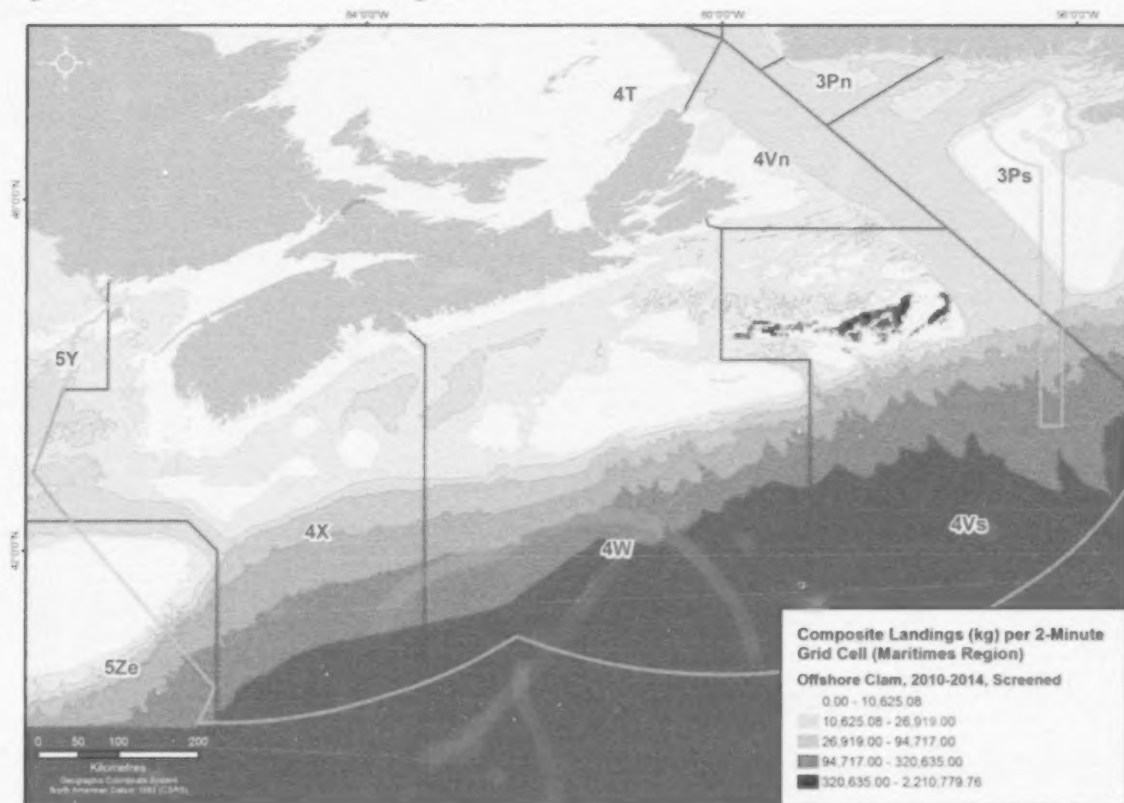
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Certified as sustainable in July 2012.

The Arctic surfclam (*Mactromeris polynyma*) fishery is concentrated on offshore clam beds on the Grand Banks and Banquereau (Figure 41). The ocean quahog (*Arctica islandica*) resource is located on Sable Island Bank and the southern Grand Banks; however, licence holders are not permitted to direct for ocean quahog on Grand Banks and no quahog harvest has occurred on Sable Island Bank in recent years. The surfclam fishery is conducted on a year-round basis commencing January 1 (DFO, 2014). There are three licences: Arctic Surf Co. Inc. (NL); Clearwater Seafoods Limited Partnership (NS); and Clearwater Seafoods Limited Partnership (NL). Specialized factory-freezer clam vessels operate year-round and the licences have equal allocations for both commercial fishing areas, Banquereau and Grand Bank. The current total allowable catch (TAC) is 24,000 tonnes on Banquereau and 14,756 tonnes on Grand Bank, for a total of 38,756 tonnes.

Figure 41.—Offshore Clam Landings, 2010–2014



Shrimp (Figure 42)

SARA Status: No Status.

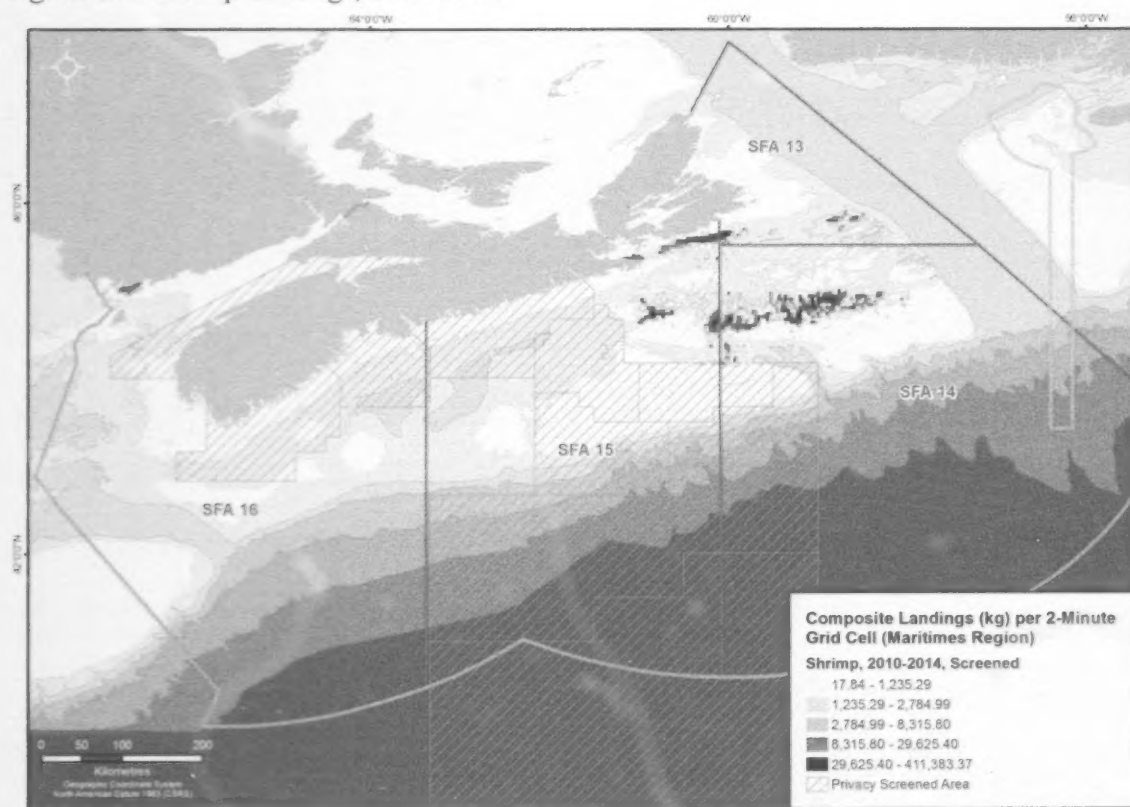
COSEWIC Status: No Status.

MSC Status: Shrimp Fishing Areas 13, 14, and 15 re-certified as sustainable on 18 February 2014.

Two species of shrimp are harvested in the Canadian Northwest Atlantic. Northern shrimp (*Pandalus borealis*) is most abundant and widespread in commercial quantities in 'holes' on the Scotian Shelf (Figure 42), and the striped shrimp (*Pandalus montagui*) is widely distributed from Davis Strait to the Grand Banks and is more abundant in northerly areas at shallower depths. The mobile shrimp fishery uses bottom otter trawls with a minimum mesh size of 40 mm. Shrimp trawl nets are equipped with a mandatory Nordmore separator grate to allow other fish to escape through the upper panel of the trawl. Shrimp in Shrimp Fishing Areas 13-15 are managed as one stock, with a TAC set each year. In SFA 13-15, the mobile fleet holds 92 percent of the TAC. Of this, 25 percent is held by Gulf-based vessels and 75 percent by Maritimes-based vessels. The mobile fleet has been operating under a system of individual transferrable quotas since 1998. Shrimp in SFA 16 may be part of the Gulf of Maine stock, which is fished competitively as there is no TAC available in this area.

A small shrimp trap fishery operates in Chedabucto Bay (SFA 15). There are 14 trap licences in total with an allocation of 100 traps each. Five trap licences are located in the north of Chedabucto Bay, eight in the south, and one along the eastern shore just south of the bay. The trap fleet is active primarily from late fall through winter. The trap fleet holds 8 percent of the TAC and trappers fish their share competitively.

Figure 42.—Shrimp Landings, 2010–2014



Offshore Lobster (Figure 43)

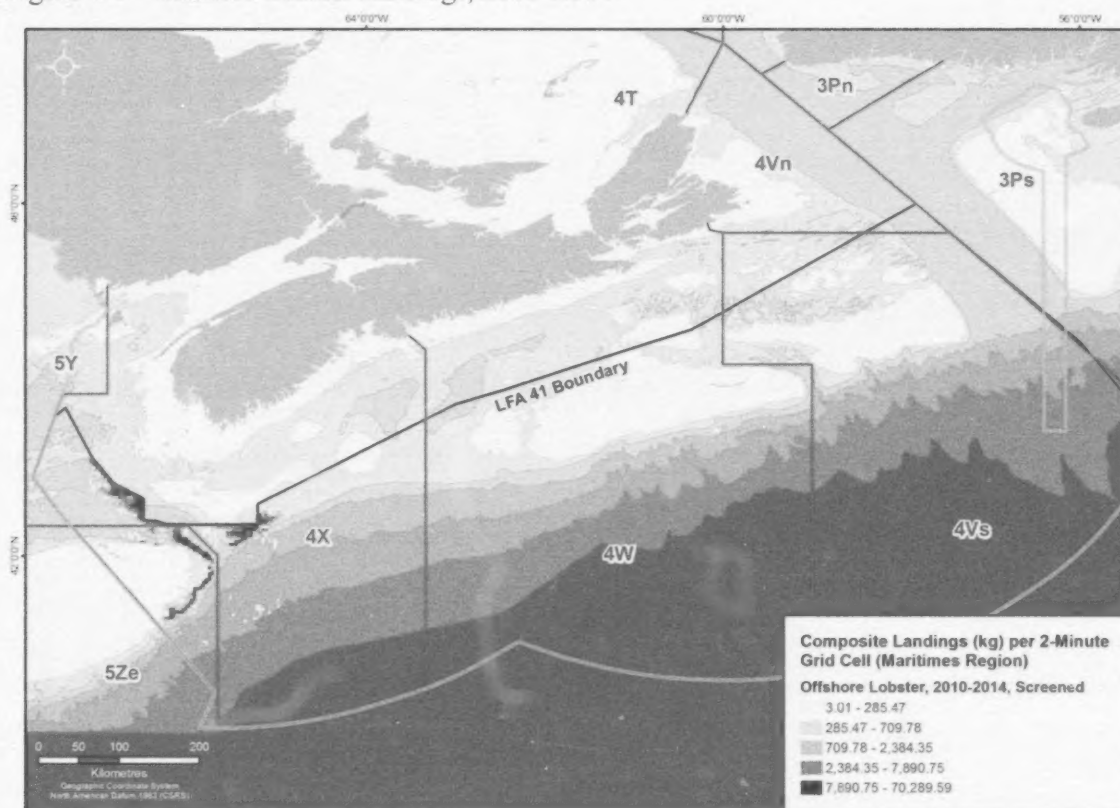
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Re-certified sustainable 30 June 2015.

Most lobster fisheries in the region report landings by inshore Lobster Fishing Area and statistical grid fished, not by lat/long coordinates. However, the offshore lobster fishery is required to report coordinates. The fishery for offshore lobster (*Homarus americanus*) occurs within the boundaries of Lobster Fishing Area (LFA) 41, as described in the *Atlantic Fishery Regulations*. LFA 41 extends from the Hague Line on Georges Bank to the Laurentian Channel off Cape Breton; however, all traditional offshore lobster and Jonah crab commercial fishing occurs on five major grounds, namely Georges Bank (outer shelf and upper slope), Georges Basin, Crowell Basin, Southeast Browns Bank (outer shelf and upper slope east of the Northeast Channel) and west Browns Bank, all within NAFO divisions 4X and 5Ze (Figure 43). The total allowable catch (TAC) for LFA 41 was established at 720 tonnes in 1985 based on landings history and has remained unchanged (DFO, 2016b).

Figure 43.—Offshore Lobster Landings, 2010–2014



Grey Zone Lobster (Figure 44)

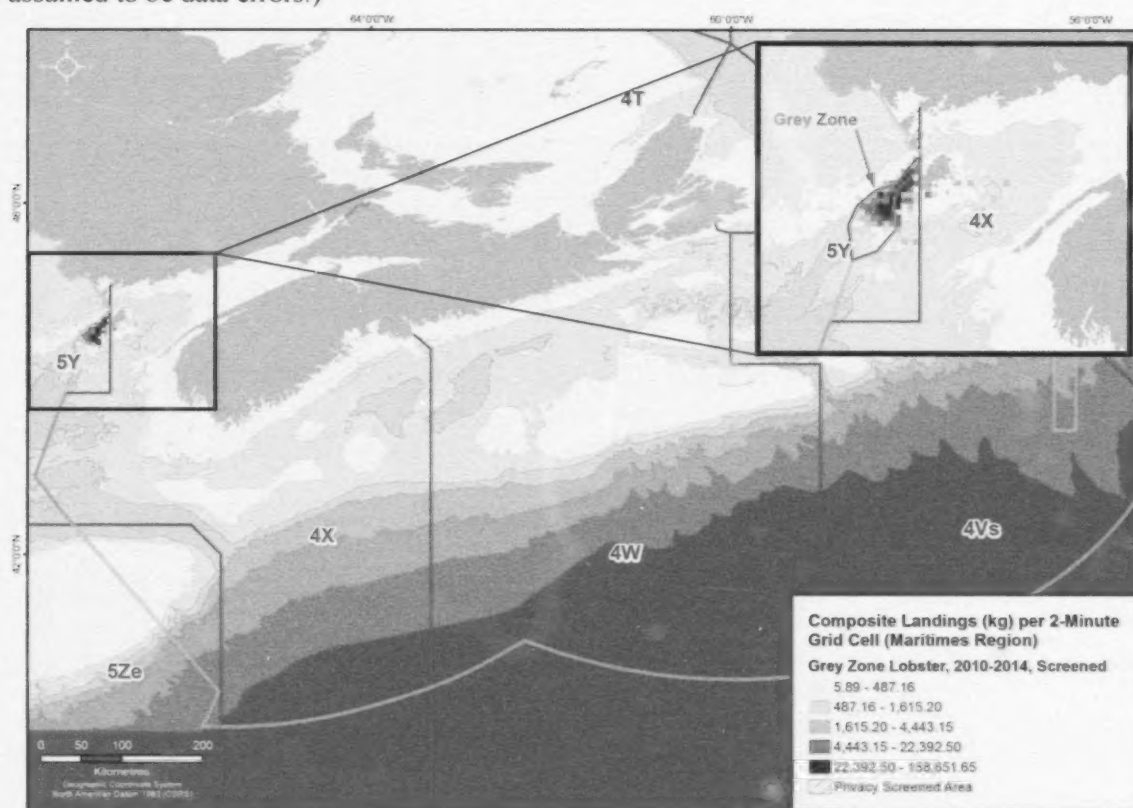
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Certified sustainable in May 2015.

Most lobster fisheries in the region report landings by inshore Lobster Fishing Area and statistical grid, not by lat/long coordinates. However, the Grey Zone lobster fishery is required to report coordinates. Figure 44 shows Grey Zone lobster landings. The Grey Zone lobster (*Homarus americanus*) fishery occurs in a disputed zone known as Area 38B (see inset map of red polygon in Figure 44), an area in Grand Manan Channel disputed between Canada and the U.S.A. (DFO, 2012). The fishing season begins June 30 and ends on the Friday preceding the opening of the regular LFA 38 lobster season on the second Tuesday in November. Only licence holders with a valid lobster licence for LFA 38 are permitted to fish in Area 38B. Access to the disputed zone is limited by the number of lobster licences in LFA 38. Single lobster licences are limited to 375 traps, while partnership lobster licences are limited to 563 traps. As a partner in the administration of Area 38B, the Grand Manan Fishermen's Association maintains an annual list of participants and provides updates to DFO as eligible licence holders are added throughout the season. Licence holders and operators are required to have a DFO-approved Vessel Monitoring System (VMS) on vessels authorized to fish any Grey Zone fishing licence. U.S.-based fishers from Maine also target lobster in the Grey Zone.

Figure 44.—Grey Zone Lobster Landings, 2010–2014 (Outlier points outside the red polygon are assumed to be data errors.)



Sea Urchin (Figure 45)

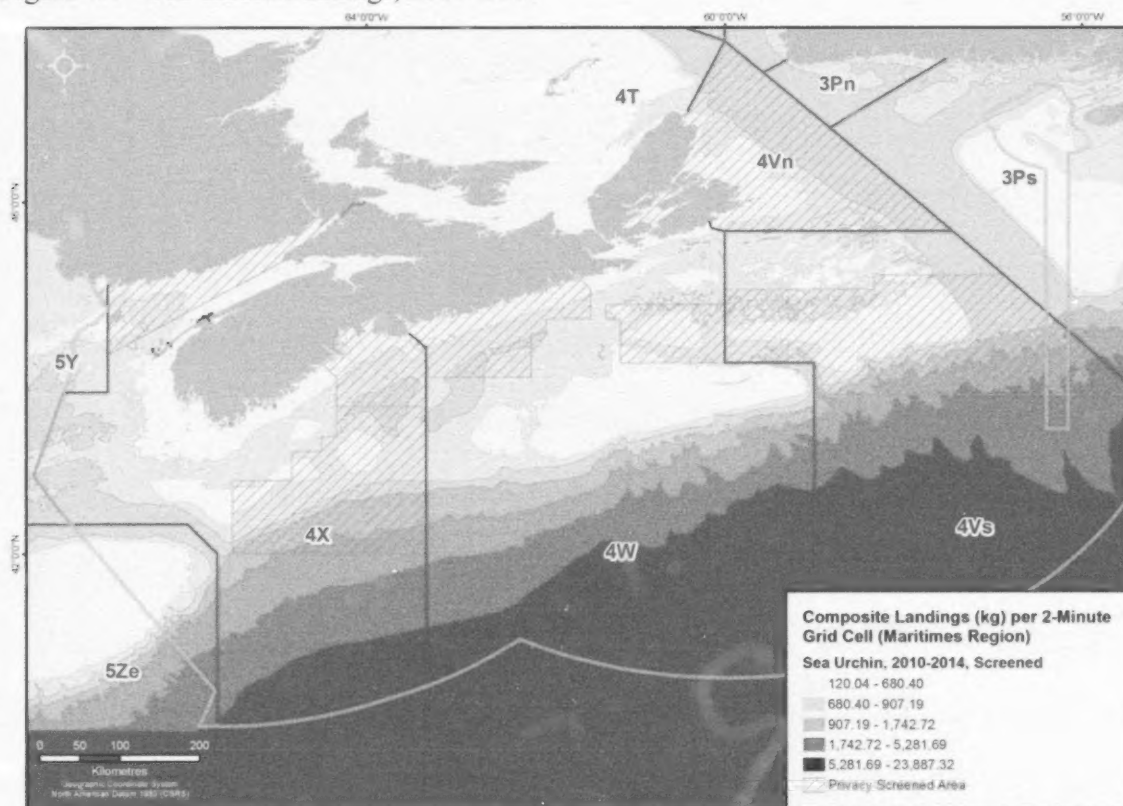
SARA Status: No Status.

COSEWIC Status: No Status.

MSC Status: Not in MSC program.

Sea urchin (*Strongylocentrotus droebachiensis*) is a commonly distributed benthic echinoderm in northern temperate waters. Sea urchins are harvested by inshore vessels using commercial divers along Nova Scotian shores, and a combination of drag fishery and divers in southwest New Brunswick (DFO, 2010a; DFO, 2010b; DFO, 2011; DFO, 2013c). In southwest New Brunswick, the fishery is managed by TACs, and in eastern and southwest Nova Scotia there are no TACs. Sea urchin fishing zones in eastern Nova Scotia only extend to 12 nautical miles. The fishery is managed through a combination of input controls and resource husbandry. Some licence holders have access to exclusive zones, while others fish areas competitively. There are 32 licences in southwest New Brunswick and 55 licences in eastern and southwest Nova Scotia. Fishing seasons are: LFA 36 - October 1 to May 15; LFA 38 - 2nd Monday of December to Friday of the second week of March; SWNS and ENS - September 1 to August 31, but September 1 to May 31 in Digby, Annapolis and Kings Counties. Privacy screening by NAFO unit area results in many sea urchin landings being screened out, as shown in Figure 45.

Figure 45.—Sea Urchin Landings, 2010–2014



ACKNOWLEDGEMENTS

The authors would like to thank Heather Breeze, Maureen Butler, Verna Docherty, Jennifer Ford, Laura Hussey-Bondt, Carl MacDonald, Sara Quigley, and Koren Spence for peer reviewing the report. We acknowledge the assistance of DFO staff to acquire commercial fisheries logbook data from three regions: Krista Wry (Maritimes Region Statistics Division), Gaëlle Lemay (Gulf Region Statistics Division), and Sandra Savory (Newfoundland and Labrador Region Statistics Division).

REFERENCES

- den Heyer, C.E., B. Hubley, D. Themelis, S.C. Smith, S. Wilson, and G. Wilson, 2015. Atlantic Halibut on the Scotian Shelf and Southern Grand Banks: Data Review and Assessment Model Update. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/051.
- DFO, 2000. Scotia-Fundy Offshore Scallop Integrated Fisheries Management Plan, Maritimes Region
- DFO, 2005. The Scotian Shelf: An Atlas of Human Activities, H. Breeze and T. Horsman, eds., (Dartmouth, Nova Scotia).
- DFO, 2008. St. Mary's Bay Longhorn Sculpin (*Myoxocephalus octodecemspinosus*) Assessment. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/051.
- DFO, 2010a. Sea Urchin Management Plan, SWNB – LFA 36.
- DFO, 2010b. Green Sea Urchin Fishery, LFA 38 Grand Manan, 2010-2011 Annual Fishing Plan.
- DFO, 2011. SWNS Sea Urchin Conservation Harvesting Plan.
- DFO, 2012. Grey Zone Multi-Species Conservation Harvest Plan.
- DFO, 2013a. Eastern Nova Scotia and 4X Snow Crab Integrated Fisheries Management Plan, Maritimes Region.
- DFO, 2013b. Canadian Atlantic Swordfish and Other Tunas Integrated Fishery Management Plan (Summary).
- DFO, 2013c. Eastern Nova Scotia Sea Urchin Conservation Harvesting Plan.
- DFO, 2014. Offshore Clams Integrated Fishery Management Plan, Maritimes and Newfoundland Regions
- DFO, 2015. Canadian Bluefin Tuna (*Thunnus thynnus*) Integrated Fisheries Management Plan NAFO Fishing Areas 3KLNOP, 4RSTVWX and 5YZ.

- DFO, 2016a. Hagfish Conservation Harvesting Plan, Maritimes Region.
- DFO, 2016b. Offshore Lobster and Jonah Crab Integrated Fisheries Management Plan, Maritimes Region.
- Kulka, D., C. Hood and J. Huntington. 2007. Recovery Strategy for Northern Wolffish (*Anarhichas denticulatus*) and Spotted Wolffish (*Anarhichas minor*), and Management Plan for Atlantic Wolffish (*Anarhichas lupus*) in Canada. Fisheries and Oceans Canada: Newfoundland and Labrador Region. St. John's, NL.
- O'Boyle, R. 2012. Fish Stock Status and Commercial Fisheries, State of the Scotian Shelf Report, available online: <<http://coinatlantic.ca/docs/fish-stock-status-and-commercial-fisheries.pdf>>.
- Stone, H.H., Themelis, D., Cook, A.M., Clark, D.S., Showell, M.A., Young, G., Gross, W.E., Comeau, P.A., and Allade, L.A. 2013. Silver Hake 2012 Framework Assessment: Data Inputs and Exploratory Modelling. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/008.
- Treasury Board Directive on Privacy Impact Assessment, 2010, available online: <<http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=18308&section=text>>.